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THE MEDIUM-TERM EMPLOYMENT OUTLOOK: CONSTRUCTION INDUSTRY

B.A. Keys and D.M. Caskie

July 1981

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THE MEDIUM-TERM EMPLOYMENT OUTLOOK: CONSTRUCTION INDUSTRY

B.A. Keys and D.M. Caskie

Three significant changes are underway or expected in the Canadian construction industry during the 1980s and 1990s:

- There is a marked shift from residential to non-residential construction. Within the residential sector major renovation is increasing sharply.
- Growth in construction will be concentrated in Alberta and Saskatchewan.
- There is a substantial increase in the number of large-scale industrial projects being planned. They are dispersed throughout Canada and their construction will require considerable numbers of skilled personnel.

Substantial shortages of pipefitters, welders, boilermakers, millwrights and engineers are forecast during the 1980s. The time of the most severe shortages will be influenced largely by the numbers, timing and location of the large-scale projects.

Though the shortages will be due mainly to these projects, for the most part they may be able to attract workers as needed and to shift the main shortages to other private and public works projects.

Comprehensive data on supply of and demand for skilled construction personnel are not available. The provinces of Nova Scotia, Saskatchewan and Alberta, as well as the United

States, have, however, initiated manpower information systems that could serve as a base from which a national system could be developed for Canada.

The first recommendation of this study calls for the establishment of a Personnel Information System that would provide short-, medium- and long-term projections of both demand for and supply of skilled construction personnel by occupation and region. Initiative for inaugurating the system should be taken by the Canada Employment and Immigration Commission (CEIC), but once established it should function independently under the direction of all major parties in the construction industry.

It is also recommended that new lines of communication and responsibility be established in the Commission to provide better coordination on a national basis of information on the supply of and demand for skilled construction personnel.

A number of other recommendations emphasize adjusting the supply of skilled personnel and include strategies for both the short term and longer term:

Short-term strategies

- Improve the incentives for, and remove the impediments to, mobility, including geographical, inter-industry, inter-sectoral and inter-occupational.

- Continue to permit immigrants to enter Canada, mostly on temporary employment authorizations and when other measures are not meeting demand satisfactorily.

- Regard overtime as a traditional solution to manpower shortages, but recognize the inflationary effects of extensive overtime wages and the potential negative effect on productivity if it is used to excess.

Long-term strategies

- Introduce standardized training and accreditation for apprentices throughout Canada. This would improve their mobility to fill job vacancies in other provinces as well as improving their chances of being able to complete their training during periods of slack demand in certain regions.

- Consider ways of modifying the traditional form of apprenticeship training to shorten the certification period.

- Train semi-skilled specialists to solve both short- and long-term manpower shortages, reduce unemployment and upgrade the skills of workers.

- Encourage the use of more technologists and technicians to relieve the shortage of engineers in construction.

- The CEIC together with the Construction Industry Development Council, should explore possibilities for improving productivity, ranging from different work arrangements and management approaches to the use of new technology.

In the event that the foregoing measures fail to increase supply sufficiently, demand may be adjusted by:

- Considering the possibility of scheduling major projects to avoid peaking of a number of them at the same time.

- Examining the possibilities of modifying the structure or size of projects.

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PERSPECTIVES D'EMPLOI A MOYEN TERME: LA CONSTRUCTION

B.A. Keys et D.M. Caskie

Trois changements importants sont en cours ou sont prévus dans l'industrie canadienne de la construction au cours des années 1980 et 1990:

- Une diminution marquée de la construction résidentielle au profit de la construction non résidentielle et une augmentation sensible des travaux de rénovation dans le secteur de la construction résidentielle.
- Une augmentation importante du nombre des grands projets de construction industrielle prévus pour l'ensemble du Canada. La mise en oeuvre de ces projets exigera un nombre considérable de travailleurs spécialisés.
- La croissance dans le secteur de la construction sera surtout concentrée en Alberta et en Saskatchewan.

On prévoit de graves pénuries de tuyauteurs, de soudeurs, de chaudronniers, de mécaniciens-monteurs et d'ingénieurs pour les années 1980. C'est surtout le nombre des grands projets de construction, le moment où ils seront mis en oeuvre et leur emplacement qui détermineront la période où ces pénuries seront le plus graves.

Les pénuries découleront principalement de ces grands projets, mais il se peut que ceux-ci puissent attirer les travailleurs nécessaires, déplaçant ainsi les principales pénuries vers d'autres chantiers du secteur privé et des travaux publics.

Il n'existe pas de données exhaustives sur l'offre et la demande de travailleurs spécialisés de la construction. Les provinces de la Nouvelle-Écosse, de la Saskatchewan et de l'Alberta, de même que les États-Unis, ont toutefois mis sur pied des banques de données sur la main-d'oeuvre qui pourraient servir de base à l'élaboration d'un système analogue pour l'ensemble du Canada.

La première proposition de l'étude vise la création d'une banque de données sur la main-d'oeuvre qui puisse fournir, selon les régions et les professions, des projections à court, à moyen et à long terme sur l'offre et la demande de travailleurs spécialisés de la construction. C'est la Commission de l'emploi et de l'immigration du Canada qui devrait mettre le système en place, mais par la suite le système devrait fonctionner indépendamment, sous la direction de tous les principaux intéressés de l'industrie de la construction.

Nous proposons en outre que de nouvelles voies de communication soient établies à la Commission et que de nouvelles attributions soient délimitées afin de mieux coordonner, à l'échelle nationale, les renseignements sur l'offre et la demande de travailleurs spécialisés de la construction.

Voici diverses propositions qui visent à l'harmonisation de l'offre et de la demande de travailleurs spécialisés et qui comprennent des stratégies à court et à long terme:

<u>Stratégies à court terme</u>

- Améliorer les mesures visant à favoriser la mobilité, notamment la mobilité entre les industries, entre les secteurs, entre les professions et la mobilité géographique, et éliminer les obstacles qui l'entravent.

- Continuer de recevoir des immigrants au Canada, surtout en qualité de travailleurs temporaires et lorsque la demande ne peut être satisfaite autrement.

- Que le surtemps soit considéré comme une solution traditionnelle aux pénuries de main-d'oeuvre, mais qu'il soit tenu compte de l'effet inflationniste des sommes versées à ce titre et de la possibilité que le recours excessif aux heures de travail supplémentaires ait des répercussions défavorables sur la productivité.

Stratégies à long terme

- Que la formation et l'accréditation des apprentis soient uniformisées au Canada. Cela améliorerait leur mobilité, leur permettant ainsi d'occuper les postes disponibles dans d'autres provinces et de terminer leur cours durant les périodes de faible demande dans certaines régions.

- Que des méthodes visant à modifier la façon classique de former les apprentis soient étudiées afin de réduire la durée des cours menant à l'accréditation.

- Que les travailleurs de spécialisation moyenne soient formés afin d'atténuer les pénuries de main-d'oeuvre à court et à long terme, de réduire le chômage et de permettre aux travailleurs de se perfectionner.

- Que des technologues et des techniciens soient davantage embauchés pour suppléer l'insuffisance d'ingénieurs de la construction.

- Que la Commission de l'emploi et de l'immigration du Canada, de concert avec le Conseil pour l'expansion de l'industrie de la construction, étudie les différentes possibilités d'améliorer la productivité, au moyen du réaménagement des horaires de travail et de mesures administratives et, même, par l'utilisation d'une nouvelle technologie.

Si ces mesures n'arrivaient pas à augmenter suffisamment l'offre, on pourrait agir sur la demande de la façon suivante:

- Songer à la possibilité d'établir un calendrier des différents chantiers pour éviter que la demande maximale de main-d'oeuvre pour chacun de ces projets se fasse sentir en même temps.

- Songer à la possibilité de modifier l'organisation ou l'envergure des travaux.

EXECUTIVE SUMMARY

Three significant changes are underway or expected in construction in Canada during the 1980s and into the 1990s:

- A marked shift is taking place from residential to non-residential construction. Within the residential sector major renovation is increasing sharply.
- Growth in construction will be concentrated in Alberta and Saskatchewan.
- There is a substantial increase in the number of large-scale industrial projects being planned. They are dispersed throughout Canada and will require considerable numbers of skilled personnel in their construction.

Substantial shortages of pipefitters, welders, boilermakers, millwrights, and engineers are forecast during the 1980s. The time the shortages will be most severe will be influenced largely by the numbers, timing, and location of the large-scale projects.

Though the shortages will be due mainly to the large projects, for the most part the latter may be able to attract workers as needed and shift the main shortages to other private and public works projects.

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The first recommendation of this study calls for the establishment of a Personnel Information System that would provide short, medium, and long-term projections of both demand for and supply of skilled construction personnel by occupation and region. Initiative for inaugurating the System should be taken by the Canada Employment and Immigration

Commission, but once established it should function independently under the direction of all major parties in construction.

It is recommended as well that new lines of communication and responsibility be established in the Commission to provide better co-ordination on a national basis of information on the supply of and demand for skilled construction personnel.

A number of other recommendations emphasize adjusting the supply of skilled personnel and include strategies for both the short-term and longer-term:

Short-term

- Improve the incentives for, and remove the impediments to, mobility, including geographical, inter-industry, inter-sectoral, and inter-occupational.
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Longer-term

- Introduce standardized training and accreditation for apprentices throughout Canada. This would improve their mobility to fill job vacancies in other provinces as well as improve their chances of being able to complete their training during periods of slack demand in certain regions.
- Consider ways of modifying the traditional form of apprenticeship training to shorten the period required for certification.
- Train semi-skilled specialists to solve both short and longer-term

manpower shortages, reduce unemployment, and up-grade the skills of workers.

- Encourage the use of more technologists and technicians to relieve the shortage of engineers in construction.
- The Canada Employment and Immigration Commission, together with the Construction Industry Development Council, should explore various possibilities for improving productivity, ranging from different work arrangements and management approaches through to the use of new technology.

In the event that the foregoing measures fail to increase the supply sufficiently, demand may be adjusted by:

- Considering possibilities of scheduling major projects to avoid peaking of a number of them at essentially the same time.
- Examining possibilities of modifying the structure or size of projects.

INTRODUCTION

The central purpose of this study was to assess the outlook through the 1980s and into the 1990s for the supply of and demand for skilled construction personnel. It was commissioned by the Labour Market Development Task Force of the Canada Employment and Immigration Commission (CEIC) and was one of six studies sponsored by the Task Force on selected industries expected to face significant changes in levels and types of personnel required in the next decade.

This study was conducted in two stages. The first called for a review of the outlook for construction activity and employment through into the 1990s and an assessment of labour imbalances that existed at present or were in prospect for the future. Also included in the terms of reference was an assessment of measures that could be taken to correct any imbalances and an outline of implications of the study for federal labour market policies.

Based on the results of the first stage, the second one called for an evaluation of labour market policies and strategies that would deal with either current or longer-term construction manpower shortages, including particular problems of the mega energy projects. It stipulated as well that a review be made of the feasibility of setting up a supply/demand information system for construction personnel and that consideration be given to a more effective role for the CEIC in manpower planning.

Because of indications that shortages already existed for skilled construction personnel in some areas, the approach taken in this assignment was to consult appropriate organizations and persons familiar with various aspects of construction manpower in order to obtain as early as possible a comprehensive picture of the supply/demand outlook for the 1980s and 1990s. Main sources of information included the national headquarters and the regional offices of the CEIC, other federal bodies

and committees or task forces associated with them, the provincial departments or ministries of Labour, educational authorities, construction trade associations including regional organizations, as well as the Canadian Construction Association, individual construction firms, the Building and Construction Trades Department of the AFL-CIO, owner-client councils representing the private buyers of construction, major project planners, and buyers of construction. In the United States, interviews were conducted with the Construction Labour Demand System (CLDS), the Department of Labour and with some of the major users of the CLDS. As will be noted throughout this report, it draws extensively in places on a number of publications, including those from the foregoing organizations.

The report looks first at the demand for skilled construction personnel, then at supply, then at supply/demand imbalances. Both tradesmen and engineers are included and residential as well as non-residential construction are covered. The report then deals with methods and procedures that could be employed to match supply and demand. These include the development of a comprehensive supply/demand information system for construction personnel and a revised role for the CEIC. In the final chapter the main conclusions are drawn from the information gathered for the report and courses of action are proposed.

The study has been based on the assumption that mega energy-related projects planned for the 1980s will be built, but with some delays in the original scheduling. The manpower implications of two other scenarios could be explored: in the event that some of the mega projects are cancelled a serious surplus of construction personnel could be foreseen; on the other hand, if foreign oil imports were diminished substantially, there would be pressure to proceed at full speed with all the planned mega energy products with resultant immense demand for manpower.

Acknowledgements

Grateful appreciation is expressed by the authors to all those who provided the information and co-operation that made this report possible. A special word of thanks is extended to Messrs. Donald Tate of the Task Force and Jean Gravel of the CEIC for their invaluable assistance and to Mrs. Irene Forde who performed so skillfully in the typing of the draft manuscripts.

Chapter I

DEMAND FOR SKILLED CONSTRUCTION PERSONNEL

The overall demand for construction labour is expected to remain slack through 1981. For the remainder of the decade, however, on the basis of the Informetrica macro-econometric model the growth of output of the construction industry is expected to exceed that of the economy as a whole, leading to a growth in the demand for construction labour of an average of 1.5 per cent per year[1]. A recent publication of the Canadian Construction Association shares this general view[2].

Trends in Investment in Construction

Within the context of overall construction activity three significant factors are prominent for the 1980s. One is an anticipated decline in the relative importance of residential construction and an increase in non-residential construction, the second a concentration of growth in Saskatchewan and Alberta, and the third, a substantial increase in the number and geographical dispersion of large-scale industrial construction projects. As shown in Table I-1, the residential share of total construction is projected to decline from just over 32 per cent in 1979 to under 20 per cent in 1990. Over the same period the share of construction expenditure for oil and gas facilities is expected to more than double, from approximately 10 per cent of total to almost 22 per cent. Other types of construction show much less significant prospective changes.

Table I-2 shows the proportion of residential construction to total construction by province and the wide regional variations in the relative importance of residential construction.

As well as declining in overall importance, residential construction is changing in nature. From 1975 to 1980 new housing declined from 67.9 per cent of total construction to 59.1 per cent, while major renovation increased from 14.0 to 20.1 per cent[3]. Repair remained fairly steady at 18 to 21 per cent

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1/ Informetrica Limited, <u>The Construction Industry in Canada, Retrospect and Prospect</u>, Ottawa, July 1980, p. 73.

2/ Canadian Construction Association, <u>The Construction Outlook From Winter 1981</u>, Ottawa, February 1981, (Prepared by William J. Nevins, Chief Economist).

3/ Canada Mortgage and Housing Corporation, <u>The Long Term Outlook for Housing in Canada, and Its Implications for The Residential Construction Industry</u>, Ottawa, May 1980, Tables 28 and 29.

TABLE I-1

Construction Expenditure by Type

(Share of Total Construction Expenditure in Current Dollars)

	1979	1980	1981	1982	1983	1984
Residential Building	32.37	29.72	30.84	31.79	29.59	27.68
Non-residential Building	24.12	24.40	23.42	22.64	23.54	24.22
Road, Highway and Aerodrome.	7.92	7.35	7.40	7.35	7.30	7.35
Gas and Oil Facilities	10.36	12.99	13.45	14.50	15.81	16.50
Dams, Irrigation and Electric Power. . .	11.18	10.95	10.59	9.71	9.53	9.81
Railway, Telephone and Telegraph	3.11	3.35	3.13	2.94	2.93	2.98
Engineering.	10.94	11.25	11.16	11.07	11.29	11.45

	1985	1986	1987	1988	1989	1990
Residential Building	25.49	23.41	22.55	22.38	20.90	19.79
Non-residential Building	24.11	24.53	25.16	25.70	25.82	26.13
Road, Highway and Aerodrome.	7.35	7.36	7.50	7.61	7.48	7.36
Gas and Oil Facilities	18.43	19.73	19.58	19.08	20.63	21.72
Dams, Irrigation and Electric Power. . .	9.81	9.77	9.84	9.90	9.69	9.46
Railway, Telephone and Telegraph	2.95	2.97	3.03	3.07	3.01	2.98
Engineering.	11.86	12.23	12.35	12.26	12.46	12.56

Source: Informetrica Limited, The Construction Industry in Canada, Retrospect and Prospect, Ottawa, July 1980, p. 55.

Table I-2

Residential Construction Investment as a Percentage
of Total Construction Investment in Canada, by Province
for 1979, 1985 and 1990

	Total Construction Investment (Millions of 1971 dollars)			Residential as a Per Cent of Total		
	1979	1985	1990	1979	1985	1990
Total Canada	15,774.12	20,725.07	26,152.92	27.5	20.8	17.1
Newfoundland	295.63	618.33	612.80	24.2	21.1	16.4
Prince Edward Island.	65.32	82.40	87.60	42.4	50.3	52.7
Nova Scotia	416.39	543.31	521.91	27.6	31.3	28.2
New Brunswick	403.97	478.53	530.30	28.8	44.1	40.7
Quebec.	4,381.14	5,214.10	6,650.86	26.0	19.0	7.5
Ontario	4,028.53	5,283.37	6,252.71	35.7	35.2	37.3
Manitoba.	543.14	620.60	789.66	31.3	35.5	38.0
Saskatchewan.	771.63	1,082.20	1,435.99	31.9	25.1	15.2
Alberta	3,261.40	4,895.13	6,499.20	26.0	10.6	8.2
British Columbia. . .	2,098.64	2,492.76	3,130.75	30.8	19.6	13.7

Source: Based on Tables D-1 and E-1 in Informetrica Limited, Provincial Construction Reference Forecast, July 1980, Ottawa. (See Appendices A-1 and A-2 to this report.)

of total. In dollar terms during the period new housing increased from $5.9 billion to $8.6 billion or by about 46 per cent, while major renovation increased by 140 per cent as owners sought to rehabilitate the aging stock of houses and to make houses more energy efficient. Officials at Canada Mortgage and Housing Corporation (CMHC) expect the trend to continue and see the possibility of investment in major renovation being close to equal that in new housing by 1990. This would have significant implications for residential construction as renovation tends to be carried out by smaller firms and a different mix of trades is involved. Moreover, renovation is found to be roughly twice as labour intensive as new housing.

In any case, as shown in Table I-3, CMHC expects employment in residential construction to drop from approximately 122,000 in 1980 to 94,000 in 1989 with all trades being affected. As the data in the table represent "requirements" that are based on demographic factors, due to lower rates of formation of new households, doubling, etc., actual demand may be considerably less and actual employment in 1989 could be substantially less than the figures shown. In 1980, for example, requirements for new housing are estimated at 235,200, whereas actual completions are expected to be about 180,000.

Table I-4 illustrates the strength of construction growth in Saskatchewan and Alberta. With the exception of Newfoundland, the latter two provinces are the only ones showing higher projected growth rates in construction investment during the 80s than the average for the whole of Canada. Newfoundland's high growth rate for the decade results from high anticipated growth in both residential and non-residential construction from 1979-85. This is followed, however, by much weaker performance from 1985-90 due to a marked decline in residential building. When reviewing these growth rates, it should be noted from Table I-2 that Newfoundland had a total construction base of only $295 million in 1979 compared with $771 million in Saskatchewan and $3.3 billion in Alberta.

In Saskatchewan, Alberta and British Columbia, as well as in Quebec, growth in construction is heavily concentrated in the non-residential sector.

Table I-3

Projection of Man-Years of Employment Generated by Requirements* by Trade - All Dwelling Types

	1980	1982	1984	1986	1988	1989
Labourer	30,266	30,619	29,502	26,974	24,211	22,947
Carpenter	30,528	31,198	30,481	28,416	26,081	24,960
Bricklayer	8,901	8,997	8,662	7,907	7,079	6,702
Painter	11,998	12,117	11,653	10,616	9,485	8,969
Plumber	6,944	7,020	6,758	6,169	5,522	5,226
Electrician	5,520	5,575	5,361	4,886	4,365	4,128
Other	27,875	28,138	27,036	24,603	21,959	20,758
	122,032	123,664	119,453	109,571	98,702	93,690

*Note: Requirements do not necessarily correspond with starts.

Source: Canada Mortgage and Housing Corporation, The Long Term Outlook for Housing in Canada, and Its Implications for the Residential Construction Industry, May 1980, Ottawa, 1980, Table 31.

Table I-4

Projected Annual Growth Rates in Construction Investment
in Canada in the 1980s, by Province and Type of Construction
(Compound Annual Rates in Per Cent)

	Residential			Non-residential			Total		
	1979-85	1985-90	1979-90	1979-85	1985-90	1979-90	1979-85	1985-90	1979-90
Total Canada	-0.2	0.7	0.3	6.2	5.7	6.0	4.7	4.8	4.7
Newfoundland	10.6	-5.1	3.1	13.9	4.7	7.8	13.1	-0.2	6.9
Prince Edward Island	6.9	2.2	4.8	1.4	0.2	0.9	3.9	1.2	2.7
Nova Scotia	6.8	-2.9	2.5	3.6	0.1	2.0	4.5	-0.8	2.1
New Brunswick	10.5	0.5	5.8	-1.4	3.3	0.8	2.9	2.1	2.5
Quebec	-2.4	-12.7	-7.2	4.5	7.8	6.0	2.9	5.0	3.9
Ontario	4.4	4.6	4.5	4.8	2.7	3.8	4.6	3.4	4.1
Manitoba	4.4	6.4	5.3	1.2	4.1	2.5	2.2	4.9	3.5
Saskatchewan	1.7	-4.3	-1.1	7.5	8.5	7.9	5.8	5.8	5.8
Alberta	-7.9	0.6	-4.1	10.4	6.4	8.6	7.0	5.8	6.5
British Columbia	-4.6	-2.6	-3.7	5.5	6.2	5.8	2.9	4.7	3.7

Source: Based on Tables D-1 and E-1 in Informetrica Limited, Provincial Construction Reference Forecast, July 1980, Ottawa, 1980.

The construction of a large number of major industrial projects across Canada is a significant change for this and the next decade. The Canadian Council of Professional Engineers has, in its report Canadian Engineering Requirements 1980-2000 for Major Energy-Related Projects, identified 84 projects with a total capital cost of approximately $205 billion, distributed from coast to coast. These projects range in capital cost from $150 million to approximately $15 billion each. Of the 84 projects, 63 or 75% are valued at $500 million or more per project. Table I-5 shows the number of projects and the capital cost by region.

Table I-5

Major Energy-Related Projects by Region

Region	Capital Cost $ Billions 1980	Number of Projects	Number of Projects With Capital Cost of More Than $500 Millions Per Project
British Columbia	9.6	14	8
Alberta	64.7	29	22
Saskatchewan & Manitoba	7.8	12	6
Ontario	9.8	5	5
Quebec	38.1	7	6
Atlantic Region	19.8	11	10
Northern Frontier	55.0	6	6
CANADA	204.8	84	63

Source: CCPE, op. cit., p. 10.

There are, in addition, projects of similar magnitude that are not energy related[1]. Also there are a number of sizable projects both in and out of the energy sector in the $50-150 million category.

In comparison with the major projects of the past, those in view for the 1980s and 1990s are different in two significant respects. First, large numbers of them are occurring at roughly the same time at different locations across Canada. In comparison, the construction of the Syncrude facilities in the 1970s occurred at a time of relatively slow demand elsewhere in Canada. And second, there is a difference in the type of construction skills needed in the 1980s and 1990s compared with previous mega projects. For instance, the construction of the St. Lawrence Seaway and the James Bay facilities required large amounts of machinery for earth moving and large numbers of medium skilled equipment operators. The energy projects of today, on the other hand, are labour intensive and require highly skilled personnel, such as pipefitters, electricians, welders, et cetera. The planned construction of a large number of geographical diverse major projects and the need for considerable numbers of highly skilled tradesmen to staff these projects have altered the nature of the construction industry for the 1980s and 1990s.

Canadian Demand in a World-wide Context

The pronounced shift from residential to non-residential construction and the concentration of growth in the West raise the prospect of significant shifts in the types of skills required and in the geographical location of increased demands. Concern is being expressed over the surges in demand that will be created by the mega projects being planned in Alberta, and to a lesser degree in Saskatchewan and British Columbia, to make Canada more self sufficient in energy supply. Before examining that situation more closely it is interesting to look at Canada in the perspective of planned or proposed world-wide energy-related projects that would require generally similar skilled construction personnel as will be involved in the Canadian projects.

1/ The Department of Industry, Trade and Commerce is currently developing a comprehensive computerized inventory of major projects.

Table I-6 indicates that among the projects scheduled for the early 1980s those in Canada represent a rather modest proportion of the total.

Table I-6

Energy-Related Projects Around the World
as at September 1980

	Recent Contract Awards		Anticipated or Planned Projects		Total	
	$ Millions	%	$ Millions	%	$ Millions	%
Canada	6,750	23	25,680	15	32,430	16
U. S.	4,130	14	72,460	42	76,590	38
Other	18,752	63	74,182	43	92,934	46
Total	29,632	100	172,322	100	201,954	100

Source: Confidential.

These figures that cover in excess of 100 different projects are not considered to be complete. An additional 40 projects have been identified but have not as yet been assigned an estimated cost. On the basis of broad orders of magnitude, however, Canadian projects are seen to probably represent less than one quarter of the total investment visualized. The possibility of major U. S. undertakings in areas such as defense and re-industrialization could further affect the total demand for skilled construction personnel in Canada and the U. S.

Demand for Skilled Trades

As indicated at the beginning of this report the study is concerned with the possibility of supply/demand imbalances in Canada by specific trade

and by region. To a considerable degree, however, information on construction labour demand is not available in such detail. In a few provinces - Nova Scotia, Saskatchewan, and Alberta - initiatives have been taken to identify demand patterns by occupation, but data of this type are not available on a national basis. The Canadian Construction Association has prepared an estimate of labour demand, but by type of contractor rather than by trade[1]. The Canadian Occupational Forecasting Model (COFOR) of CEIC produces annual growth rates for all construction skilled trades as a group. The latest estimates, including revisions by the Labour Market Development Task Force, are at considerable variance, however, from the Informetrica projections of construction investment. Since patterns of labour demand can be expected to be generally consistent with investment, data from Table I-4 on projected construction investment is used in the following review of the outlook for trends in demand for skilled construction personnel by province. No overall indication is provided, of course, of the demand by individual trade.

1) Newfoundland

Projected annual growth rates in construction investment:

1979-85	1985-90
13.1	-0.2

No quantitative projection of construction labour requirements is available in Newfoundland. In the short term, high demand is reported for bricklayers and the possibility of growing demand for plumbers and electricians. Longer-term demand is seen to depend largely on the off-shore discovery of significant quantities of oil and on the development of Lower Churchill power generating facilities.

1/ Op. cit.

2) Prince Edward Island

Projected annual growth rates in construction investment:

1979-85	1985-90
3.9	1.2

Officials in Prince Edward Island report that demand for construction trades is currently low - as is the demand for construction - and both are expected to remain low at least for the first half of the decade. Most construction in this province is purchased by governments and prospects for significant increases (by P.E.I. standards) are dependent upon approval for a Veteran Affairs building and a veterinary college.

3) Nova Scotia

Projected annual growth rates in construction investment:

1979-85	1985-90
4.5	-0.8

Nova Scotia is one of the few provinces that undertakes to project its forward construction manpower requirements and, in the process, prepares estimates of anticipated construction activity. The latter indicate annual growth of 2.7 per cent from 1980-83, still at variance with the modified COFOR manpower growth of only 0.6 per cent for the longer period[1]

Table 1-7 shows the degree of disaggregation to which Nova Scotia projects its requirements for construction tradesmen. Its approach and procedures will be outlined more fully in the section of Chapter IV that deals with information systems, and in Appendix C-1. This table indicates that from 1980-83 total construction manpower requirements are expected to increase from 26,939 to 29,955 or an average annual rate of 3.6 per cent, a figure that is reasonably - but probably not as close as one might expect - in line with their anticipated growth of 2.7 per cent in construction investment during the same period. If labourers and helpers are excluded from the manpower projections, requirements for skilled trades would grow at 4.0 per cent per year from 1980-83. Highest demand among the trades is seen for pipefitters and plumbers, carpenters and equipment operators.

1/ Department of Labour, Province of Nova Scotia, Information Bulletin, November 1979, Halifax, 1979.

Table I-7

Manpower Requirements by Trade
for the Nova Scotia Construction Industry
Residential and Non-residential
1980 - 1983

Residential and Non-residential	1980	1981	1982	1983
Supervisors	1,502	1,462	1,507	1,656
Carpenters	3,781	3,780	3,889	4,089
Pipefitters and Plumbers	2,077	2,068	2,174	2,436
Cement Masons	426	433	452	479
Electricians	2,032	1,996	2,116	2,129
Operators	2,980	3,066	3,128	3,185
Labourers & Helpers	5,585	5,446	5,628	5,919
Teamsters	985	1,056	1,100	1,095
Insulators	288	244	256	302
Rodmen Ironworkers	443	459	488	526
Structural Ironworkers	398	352	366	446
Welder Ironworkers	48	27	26	48
Boilermakers	230	152	150	241
Boiler Welders	141	102	102	151
Millwrights	128	95	95	137
Pipe Welders	547	495	503	591
Bricklayers	351	345	338	328
Plasterers and Lathers	72	71	69	67
Electrical Mechanics	7	7	7	7
Sheet Metal Workers	69	68	66	64
Roofers	38	38	37	36
Others	4,620	4,640	4,932	5,453
TOTAL	26,939	27,213	27,746	29,955

Source: Construction Trades Inventory, Nova Scotia Department of Labour.

NOTE: Small addition differences due to rounding.

4) New Brunswick

Projected annual growth rates in construction investment:

1979-85	1985-90
2.9	2.1

Manpower projections are not available in this province, but officials there expect a decline in investment over the next two or three years after activity peaked in 1979 when some major projects were underway. Demand for construction trades is seen to be generally low to moderate.

5) Quebec

Projected annual growth rates in construction investment:

1979-85	1985-90
2.9	5.0

The Quebec Construction Office, the arm of the provincial government that has responsibility for seeing that manpower needs are met, expects hours worked in construction in the early 80s to be below average levels of the 70s[1]. During the first half of 1980 hours worked were 12 per cent below the comparable period in 1979 and 29 per cent below the average for the first half of each year from 1972-79. From this low 1980 base an increase of 7 per cent is projected for 1981 and 1982.

6) Ontario

Projected annual growth rates in construction investment:

1979-85	1985-90
4.6	3.4

The Owner-Client Council of Ontario prepared detailed projections of quarterly demand for manpower by trade (Appendix C-2). The latter indicate a drop in demand for construction manpower from 1980 to 1981 and then an increase in 1982 of under 5 per cent over 1980 levels. The Council represents only industrial buyers of construction and only an estimated 70 per cent of total construction in this sector.

1/ Daily Commercial News, October 24, 1980.

Overall, Ontario CEIC officials foresee an increase in industrial and residential construction over the next five years with steadily increasing demand for construction trades.

7) Manitoba

Projected annual growth rates in construction investment:

1979-85	1985-90
2.2	4.9

In Manitoba the outlook, at least until 1984, is for low activity in construction and weak demand for all construction trades.

8) Saskatchewan

Projected annual growth rates in construction investment:

1979-85	1985-90
5.8	5.8

According to the quarterly Occupational Review of the Saskatchewan Regional Office of CEIC, the province is currently (July 1980) experiencing rather severe shortages of millwrights, machinists, combination welders, and heavy duty mechanics. During the next five years approximately 3,600 additional tradesmen will be required to fill current openings and to staff planned major projects. As shown in Table I-8 the province expects to lose close to 800 tradesmen to Alberta, bringing Saskatchewan's total demand for new tradesmen to approximately 4,350. Greatest demand will be for heavy equipment operators, pipefitters and pipefitter welders, carpenters, electricians, and structural steel workers.

9) Alberta

Projected annual growth rates in construction investment:

1979-85	1985-90
7.0	5.8

The Alberta Department of Advanced Education and Manpower estimates that the demand for new construction workers will increase from about 105,000 in 1979 to 137,000 in 1985, an average annual increase of 4.5 per cent.

Table I-8

Saskatchewan
Current and Future Trades Demand
1980 - 1985

CCDO	Occupation	Current Demand	Sask. Major Projects Demand[1]	Alberta Drain[2]	Total
8311-110	Tool and Die Maker	2	-	-	2
8313-154	Machinist	21	22	-	43
8333-118	Sheet Metal Worker	6	49	11	66
8335-122	Welder, Pressure	-	163	8	171
8335-126	Welder, Comb.	18	60	-	78
8337-122	Structural Steel Fitter	-	214	32	246
8533-110	Electrician, Ind.	1	258	43	302
8584-122	Millwright	26	222	11	259
8584-378	Heavy Duty Mechanic	6	185	-	191
8711-110	Heavy Equip. Opr.	-	394	174	568
8733-122	Electrician, Const.	4	258	43	305
8781-110	Carpenter	-	378	51	429
8782-110	Bricklayer	-	22	-	22
8783-122	Cement Finisher	-	152	6	158
8786-118	Insulator	-	92	67	159
8791-110	Pipefitters	1	337	141	479
8791-118	Pipefitter, Welder	-	267	79	346
8793-114	Structural Steel Ironworker	-	229	40	269
9175-110	Truck Driver	-	205	60	265
	TOTAL	85	3,507	766	4,358

Source: Employment and Immigration Canada, Saskatchewan Occupational Review, 2nd Quarter 1980, Regina, 1980, p. 12.

Excluding labourers and helpers, the annual increase remains at 4.5 per cent for 1979-85; but it drops to 0.2 per cent from 1985-90. Demand by occupation is shown in Table I-9 that indicates greatest demand will be for electricians, plumbers and pipefitters, carpenters, and operating engineers.

10) British Columbia

Projected annual growth rates in construction investment:

1979-85	1985-90
2.9	4.7

A recent survey by the Vancouver Board of Trade found that 88 per cent of the firms sampled had difficulty hiring skilled tradesmen over the past two years. Officials do not believe there are serious shortages in construction due largely to immigration from other provinces. The Construction Industry Advisory Council is initiating a Critical Skills Survey to determine demand for individual construction trades over the next three years. The Council is a joint body of the provincial government, labour and business.

Demand for Engineers

Three forecasts of the demand for engineers have recently appeared. The Ministry of State for Science and Technology (MOSST) prepared a report in August 1980 entitled The Requirements for Engineering Graduates to 1985. It is based on their Highly Qualified Manpower (HQM) model and data base. The Technical Service Council (TSC) published in October 1980 a report prepared by E. B. Harvey and K. S. R. Murthy entitled Supply of and Demand for Engineers in Canada, which provides projections for the period 1980-1990.

In its February 1981 publication Engineering Manpower Requirements 1980-2000 for Major Energy-Related Projects in Canada, the Canadian Council of Professional Engineers (CCPE) has made forecasts of engineering requirements for the design, pre-construction, construction and operational phases of these energy mega projects.

From the MOSST forecasts, unfortunately, information on the future demand for engineers is by type of engineer rather than by industry. Table I-10 shows the requirements for engineers from 1971 to 1980, with forecasts to the

Table I-9

Forecast of Demand for Construction Manpower
Alberta, 1978 - 1988

Occupation	1978	1979	1980	1981	1982	1983
Supervisors, Technical & Clerical	4,665	5,166	5,130	5,333	5,603	5,836
Carpenters	12,058	12,432	12,774	13,078	14,101	14,178
Plumbers & Pipefitters	11,298	12,310	12,057	12,847	14,083	14,881
Pressure-B Welders	2,928	3,008	3,011	3,532	3,884	4,364
Cement Masons	2,158	2,299	2,303	2,427	2,546	2,621
Electricians	11,488	13,107	13,104	13,705	14,851	16,342
Operating Engineers	5,900	5,782	6,181	7,090	7,685	8,644
Labourers & Helpers	26,257	26,082	28,203	29,648	30,312	31,782
Millwrights	620	611	595	800	1,005	1,025
Teamsters	2,860	2,721	2,966	3,349	3,610	4,238
Insulators	1,093	1,076	1,022	1,058	1,308	1,359
Ironworkers	3,486	3,572	3,563	3,701	4,145	4,642
Boilermaker Riggers	655	729	812	1,108	1,481	2,014
Others	15,146	16,361	15,340	14,946	14,886	14,347
TOTAL	100,612	105,256	107,061	112,622	119,500	126,273

Source: Alberta Department of Advanced Education and Manpower, The Construction Industry; Activity, Labour Demand and Supply, Alberta, 1979-1988, December 1979, Edmonton, 1979, Table 6.

Table I-9 (continued)

Occupation	1984	1985	1986	1987	1988
Supervisors, Technical & Clerical	6,171	6,521	6,948	7,335	7,599
Carpenters	15,077	15,520	15,886	16,212	16,666
Plumbers & Pipefitters	17,527	18,157	17,939	17,883	17,204
Pressure-B Welders	4,760	4,656	4,478	4,253	4,153
Cement Masons	2,734	2,902	3,048	3,174	3,286
Electricians	17,798	18,657	19,447	20,370	21,439
Operating Engineers	8,603	8,355	8,079	7,961	8,314
Labourers & Helpers	32,647	33,556	35,541	35,258	37,408
Millwrights	1,147	1,172	1,119	1,184	1,146
Teamsters	4,356	4,353	3,903	3,840	4,089
Insulators	1,515	1,965	1,606	1,558	1,307
Ironworkers	4,848	4,771	4,538	4,471	4,571
Boilermaker Riggers	2,266	1,974	1,666	1,634	1,618
Others	14,280	14,231	13,006	13,516	12,919
TOTAL	133,729	136,790	137,204	138,649	141,719

Table I-10

Requirements for Engineers

1971 - 1985

	Engineering Occupations										
	Chemical	Civil	Electrical	Mechanical	Metallurgical	Aeronautical	Mining	Petroleum	Industrial	Others	Total
1971	3,157	15,473	9,724	6,950	676	651	1,375	1,081	4,408	2,584	46,079
1972	3,271	16,868	10,729	7,555	716	704	1,452	1,158	4,630	2,809	49,892
1973	3,391	18,189	11,855	8,237	761	767	1,530	1,242	4,882	3,021	53,875
1974	3,463	19,466	12,991	8,831	786	817	1,652	1,365	5,023	3,227	57,621
1975	3,526	20,976	14,301	9,567	814	865	1,817	1,524	5,152	3,466	62,008
1976	3,573	21,924	15,266	10,055	828	893	1,955	1,656	5,227	3,633	65,010
1977	3,670	22,545	16,025	10,501	852	928	2,025	1,729	5,375	3,748	67,398
1978	3,770	23,175	16,716	10,898	874	962	2,075	1,782	5,528	3,872	69,652
1979	3,900	24,039	17,410	11,330	903	998	2,123	1,829	5,722	4,024	72,278
1980	4,054	25,180	18,146	11,823	938	1,036	2,207	1,905	5,945	4,214	75,448
1981	4,212	26,397	18,890	12,351	975	1,074	2,298	1,984	6,177	4,418	78,776
1982	4,341	27,452	19,546	12,807	1,006	1,105	2,374	2,048	6,369	4,598	81,646
1983	4,450	28,297	20,094	13,186	1,031	1,132	2,428	2,094	6,534	4,748	83,994
1984	4,552	29,061	20,568	13,515	1,054	1,156	2,479	2,138	6,686	4,883	86,092
1985	4,659	29,827	21,022	13,835	1,078	1,181	2,530	2,181	6,843	5,019	88,175

Source: MOSST, HQM Model and Data Base, 1978.

year 1985. With the possible exception of aeronautical engineers, all of the types of engineers can be found, to varying degrees, throughout the construction industry (S.I.C. 404-421) or in construction activity carried on by other industries; i.e., "own account" construction. Table I-11 shows the annual increases in total demand for engineers, including both graduate degrees and first degrees. This table points up the large numbers of engineers to be required for non-engineering occupations. Slightly more than 5,000 graduates are needed annually between 1980 and 1984, with a slight decline indicated for 1985.

Information is available from the 1971 Census on the industries in which the various types of occupations were employed (Table I-12). At that time 7 per cent of engineers were employed in construction. There is no way of knowing, however, whether this 1971 pattern would be in effect today.

The Technical Service Council, using similar data but a different methodology, arrives at different levels of demand than those cited by MOSST. The advantage of the TSC model for the purpose of this study of construction is that it provides information on demand by the industrial sector. As well, it provides three demand scenarios, slow, moderate and rapid growth; their "best estimate" is for moderate growth.

The overall demand for engineers, as seen by the TSC is presented in Table I-13. The number of additions needed on an annual basis is presented in Table I-14.

The CCPE has developed its forecast according to the following steps: (a) by identifying energy-related projects worth over $100 million in capital cost, (b) characterizing each project by type of technology and consequently the engineering personnel requirements per project and (c) summing the project forecasts to produce provincial and national engineering requirements. The forecast of total engineering requirements by province for mega energy projects is reproduced in Table I-15. This table shows a statistically averaged demand of approximately 15,000 engineers per year in Canada, with the largest demand occurring for projects located in Alberta

Table I-11

Engineering Graduates Required for Engineering Occupations

(Number of Graduates - All Degree Levels)

Engineering Occupations	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Chemical	23	24	18	17	14	21	22	26	29	30	26	24	24	25
Civil	1,389	1,334	1,304	1,492	1,055	802	816	1,009	1,234	1,304	1,187	1,033	980	993
Electrical	977	1,080	1,092	1,237	966	806	759	769	809	822	758	678	626	618
Mechanical	649	716	647	769	566	536	499	532	588	621	566	507	472	469
Metallurgical	38	43	28	32	23	30	28	34	38	41	37	33	32	33
Aeronautical	56	65	54	53	38	44	44	46	49	49	44	41	39	41
Mining	83	85	117	147	129	81	66	65	91	96	85	69	67	67
Petroleum	63	68	94	118	100	63	51	47	66	69	59	49	48	48
Industrial	173	190	134	129	103	143	147	171	188	194	175	162	158	162
Other Engineer	130	124	121	137	105	82	87	100	117	124	114	101	96	97
Total Engineers	3,581	3,729	3,609	4,131	3,099	2,608	2,519	2,799	3,209	3,350	3,051	2,697	2,542	2,553
Other HQM Occupations	2,297	2,493	2,630	2,715	2,349	2,292	2,301	2,197	1,981	1,868	2,082	2,475	2,581	2,188
Total Graduates Required	5,878	6,222	6,239	6,846	5,448	4,900	4,820	4,996	5,190	5,218	5,133	5,172	5,123	4,741

Source: MOSST, HQM Model and Data Base, 1978.

Table I-12

Number of Engineers by Industry - 1971

(Adjusted Census Data)

Engineering Occupations	INDUSTRY Mining	Durables	Non-Durables	Construction	Utilities	Transp. Comm.	Trade	Education	Services to Business	Fed. Admin.	Other Public Admin.	Other Industry	Total
Chemical	180	393	1,798	69	65	55	69	83	227	88	88	42	3,157
Civil	330	1,086	599	2,466	755	1,177	174	312	4,314	995	2,676	589	15,473
Electrical	98	2,563	462	257	1,643	2,157	286	176	1,194	537	198	153	9,724
Mechanical	223	2,482	1,200	267	267	278	280	139	1,091	302	182	239	6,950
Metallurgical	87	437	17	8	0	4	8	8	78	21	4	4	676
Aeronautical	2	319	10	0	0	143	17	6	21	101	10	22	651
Mining	888	79	14	20	3	3	10	14	222	24	65	33	1,375
Petroleum	616	16	109	16	16	39	66	0	117	31	47	8	1,081
Industrial	151	1,924	964	63	77	249	148	18	322	189	110	193	4,408
Others	68	291	241	65	108	65	68	47	643	219	650	119	2,584
Total	2,643	9,590	5,414	3,231	2,934	4,170	1,126	803	8,229	2,507	4,030	1,402	46,079

Source: Estimates by MOSST Based on 1971 Census

Table I-13

Projected Total Demand for First Degree and Graduate Engineers
in Construction in Canada, 1980 - 1990
(Moderate Growth Scenario)

	Construction		Total All Industries	
Year of Employment	Number	Total % Change	Number	Total % Change
1980	4,594		83,553	
1981	4,794	4.4	86,898	4.0
1982	5,070	5.8	90,486	4.1
1983	5,353	5.6	94,512	4.4
1984	5,720	6.9	98,023	3.7
1985	6,033	5.5	101,586	3.6
1986	6,232	3.3	104,719	3.1
1987	6,443	3.4	107,776	2.9
1988	6,726	4.4	110,780	2.8
1989	7,004	4.1	113,597	2.5
1990	7,187	2.6	116,388	2.5
Average % Change		4.6		3.4

Source: Technical Service Council, Supply of and Demand for Engineers in Canada, Toronto, 1980, Tables 3:9 and 3:12.

Table I-14

Projected Annual Demand for Engineers by Degree Level

Canada, 1980 - 1990

(Supposing a Moderate Growth Scenario)

Year	First Degree			Graduate Degree			First and Graduate Degree		
of Employment	Net New Demand	Replacement	Total	Net New Demand	Replacement	Total	Net New Demand	Replacement	Total
1980	2,857	1,351	4,208	386	194	580	3,243	1,545	4,788
1981	2,929	1,405	4,334	416	202	618	3,345	1,607	4,952
1982	3,143	1,463	4,606	445	210	655	3,588	1,673	5,261
1983	3,502	1,528	5,030	524	219	743	4,026	1,747	5,773
1984	3,073	1,585	4,658	438	228	666	3,511	1,813	5,324
1985	3,100	1,642	4,742	463	236	699	3,563	1,878	5,441
1986	2,711	1,692	4,403	422	244	666	3,133	1,936	5,069
1987	2,639	1,741	4,380	418	252	670	3,057	1,993	5,050
1988	2,601	1,789	4,390	403	259	662	3,004	2,048	5,052
1989	2,456	1,835	4,291	361	266	627	2,817	2,101	4,918
1990	2,408	1,879	4,287	383	273	656	2,791	2,152	4,943

Source: Technical Service Council, Supply of and Demand for Engineers in Canada, Toronto, 1980.

Table I-15

FORECAST ENGINEERING MANPOWER REQUIREMENTS FOR MEGA ENERGY PROJECTS 1980 - 2000

(The classification is by project location - not the location of the actual engineering work - see pages 20,21)

	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	MARITIMES & EAST COAST	NORTHERN FRONTIER	TOTAL
1980	692	7,611	91	-	1,386	304	1,126		11,210
1981	1,381	7,650	22	-	243	304	2,946	2,815	15,361
1982	1,309	2,909	14	124	72	2,099	3,284	1,410	11,221
1983	1,245	3,674	11	124	534	2,099	2,534	475	10,696
1984	490	2,342	11	84	1,437	271	3,056	97	7,788
1985	91	2,806	86	84	1,540	271	3,455	2,778	11,111
1986	219	4,139	506	11	397	191	1,990	11,528	18,981
1987	263	8,484	1,277	149	226	191	542	19,007	30,139
1988	113	9,829	956	146	688	191	439	14,073	26,435
1989	216	4,700	334	106	1,774	191	492	4,203	12,016
1990	214	5,909	206	106	2,324	191	2,008	4,648	15,606
1991	419	10,056	226	22	1,643	2,171	5,472	12,523	32,532
1992	418	10,061	52	22	1,877	2,171	5,472	12,273	32,346
1993	356	5,361	129	18	1,799	1,836	2,222	5,168	16,889
1994	356	4,290	124	18	608	1,836	682	2,768	10,682
1995	359	3,285	124	18	545	1,629	844	3,143	9,947
1996	359	2,941	124	18	584	1,629	844	3,143	9,642
1997	366	3,336	124	340	536	431	682	2,768	8,583
1998	366	3,306	223	340	666	431	1,052	3,923	10,307
1999	207	3,256	223	44	666	381	1,052	3,923	9,752
2000	208	3,166	135	44	666	381	1,052	3,923	9,575
TOTAL	9,647	109,111	4,998	1,818	20,211	19,199	41,246	114,589	320,819
AVERAGE	459	5,196	238	87	962	914	1,964	5,457	15,277

Source: CCPE, Engineering Manpower Requirements 1980-2000 for Major Energy Projects, Table 4.1, p. 25.

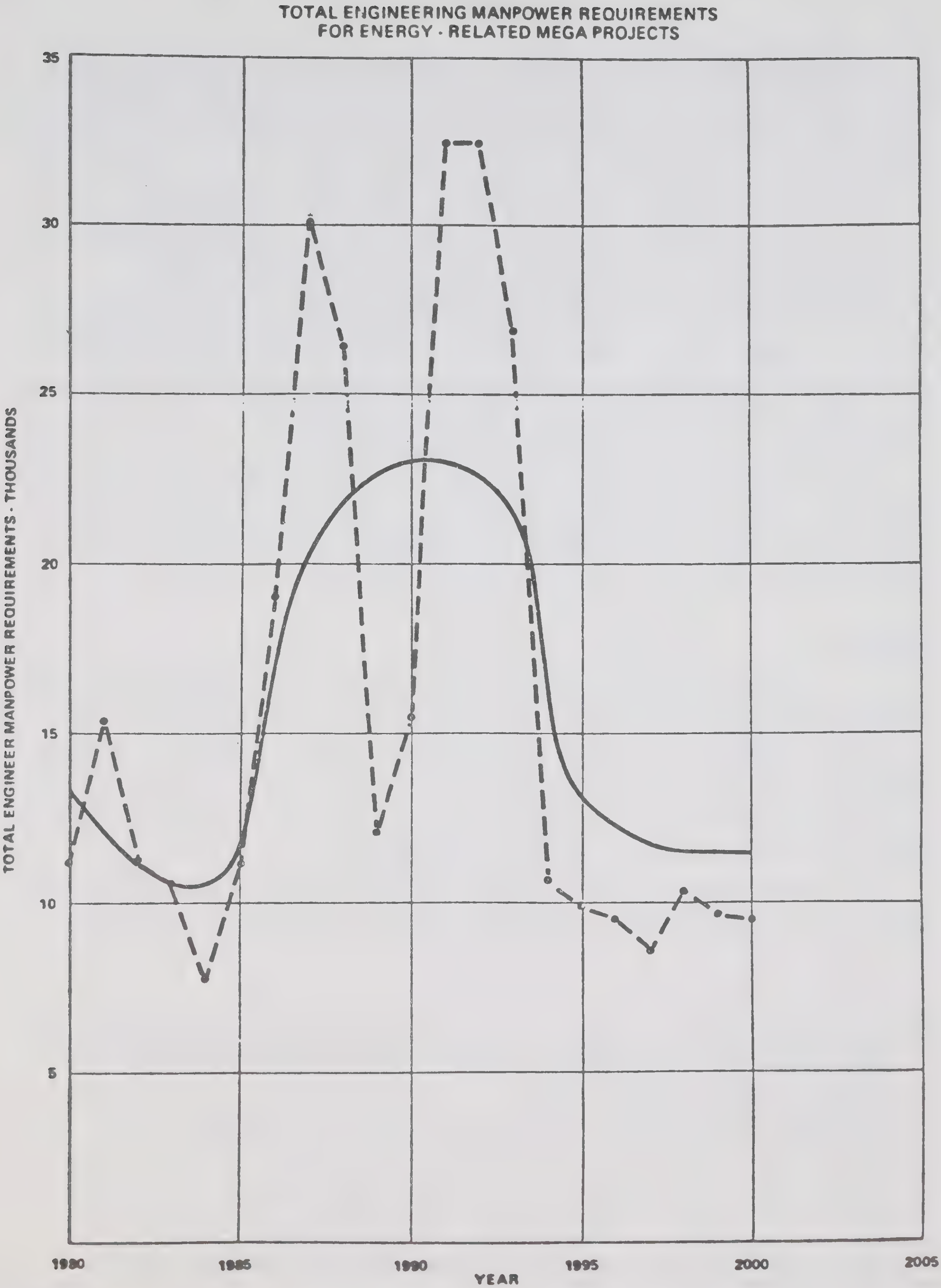
and the Northern Frontier. This information on a national basis is presented in graphic form in Chart I-1, with the information in the dotted line representing actual year-to-year fluctuations, and that in the unbroken line as a smoothed forecast that reduces much of the impact of year-to-year changes in timing of the projects. This chart shows some declines in total requirements until 1984, increases to a peak in the early 1990s and a steady dropping off in demand until 2000. In the energy sector, however, there are many smaller energy projects currently underway which should decrease the slight downward trend to 1984; also any acceleration in the timetable of the large projects could increase the growth very abruptly. The decline forecast for the 1990s is reflective of the fact that no new frontier projects not currently announced were included in the inventory. These forecasts refer to total engineering requirements (i.e., engineering done both in Canada by Canadians or immigrants and offshore). The demand for Canadian engineers will depend on several factors, including availability of skills, hiring practices, perceived availability of Canadians, type of contractors, et cetera; the CCPE forecast expects that Canadian engineering manpower content will increase to 90% of the total by the year 2000 from 70% in 1980. However, this expectation may be overly optimistic.

In comparing the annual increases in demand forecast by MOSST and TSC, MOSST is slightly higher for 1980 and 1981, but moderately lower between 1982 and 1985. The differences in the total number of engineers in demand are substantial, however, with TSC being approximately 8,000 higher than MOSST in their predictions for 1980. For further comparison, the membership in the Canadian Council of Professional Engineers for 1979 was 101,144 - very much higher than either the MOSST or TSC estimates for 1980.

MOSST estimates of increases in demand average 3.2 per cent per year from 1980-85; those of the TSC average 4.0 per cent.

The CCPE forecast for major energy-related projects shows the pattern of rapid growth and contraction in demand on a year-by-year basis, depending on the actual timing of the projects listed and the introduction of new projects currently unforeseen. For instance, the national peak demand

Chart I-1



Source: CCPE, Engineering Manpower Requirements 1980-2000 for Major Energy Projects, Figure 4.1, p. 26.

of 32,532 engineers in 1991 is double the demand for the previous year and approximately four times higher than the lowest level of demand indicated for the year 1984. Even more dramatic fluctuations are seen at the provincial level.

There does seem to be general agreement that the demand for engineers will continue at quite high levels, especially for industrial construction, including large-scale energy and engineering projects. A significant proportion of total demand is expected to be in specialties related to energy; viz., chemical, civil, electrical, industrial, mechanical and petroleum engineers on projects located in Alberta, the Northern Frontier and probably in the offshore area of the Atlantic Region[1].

Demand for engineering technicians and technologists is expected to parallel that for professional engineers. The Labour Market Development Task Force of CEIC estimates growth in requirements for the former group at 2.7 per cent annually from 1979-85 and 2.9 per cent from 1985-90.

Summary

Growth in demand for skilled construction personnel is concentrated in Saskatchewan and Alberta with the former requiring approximately 4,300 additional tradesmen and the latter 24,400, exclusive of labourers, by 1985. Demand will be heaviest for carpenters, electricians, plumbers and pipefitters, equipment operators, and structural steel workers. Growth is expected to peak between 1983 and 1985 but to continue through to 1990.

Later in this report, particularly with regard to Chart III-1, it would appear that demand for construction labour might drop dramatically

1/ See also Canada Employment and Immigration Commission, Engineering and Technical Manpower in Alberta, unpublished study prepared by Lorne Blackman, Edmonton, 1980, and

C. Humble, "Engineering, Geological and Geophysical Manpower Demand in the 1980's (Projections by Looking at New Projects)", and

B. Lamarre, "Engineering, Geological and Geophysical Manpower Demand in the 1980's (Projections Based on Job Vacancy Data)",

both in Association of Professional Engineers, Geologists and Geophysicists of Alberta, Proceedings of the Banff Workshop, Banff, March 1980, Edmonton, 1980.

after 1984. Aside from the fact that some of the mega projects may be delayed, industry observers expect that other major energy projects are likely to follow those currently planned and they see demand for construction manpower continuing relatively strong throughout the 1980s and into the 1990s.

Demand for engineers in construction is expected to increase substantially through into the 1990s, though it may fluctuate rather widely with the timing of major projects.

Chapter II

SUPPLY OF SKILLED CONSTRUCTION PERSONNEL

Data on the supply of construction manpower, particularly by skilled trade, are even scarcer than are data on demand as discussed in the previous chapter. This is, no doubt, partly due to measurement difficulties as tradesmen move in and out of construction when the industry experiences its typical cyclical pattern of activity. It is possibly for this reason that not much attempt appears to have been made to measure the supply of skilled construction personnel on a comprehensive, consistent basis. Even the sophisticated manpower planning model developed by the U. S. Department of Labour, and about which more will be said in Chapter IV, is addressed to demand only.

Supply of Skilled Trades

The Current Supply

The number of construction trades personnel currently available to the construction industry is calculated to be 620,000 (Table II-1). This figure includes union membership of about 332,000 and non-union workers estimated to number almost 286,000. Single family and low-rise residential construction is almost exclusively built by non-union workers. In addition, some industrial and engineering construction is conducted by non-union workers employed by non-union contractors.

However, not all workers in occupations considered as construction trades work in the construction industry. In 1971, for instance, only 62.5 per cent of those in construction occupations were employed in this industry (Table II-2). The remainder were working in other industries possibly as part of their "own account" construction force (e.g., utilities) or in maintenance or repair positions, or perhaps as an integral part of the production process

Table II-1

The Current Supply of Construction Workers
in Canada, 1980

UNION	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.	N. B.	N. S.	NFLD.	P.E.I.	YUKON	TOTALS
Boilermakers	1040	1300	200	450	1600	678	250	600	300	-	-	6418
Brick Layers	1030	940	85	433	5000	2696	400	390	250	50	-	11274
Carpenters	10968	7373	1521	750	15000	19619	2100	2100	1800	170	175	61576
Cement Masons	517	625	130	175	1500	1328	150	60	100	-	-	4585
Electricians	5038	1900	420	840	9454	8271	700	1100	900	220	-	28843
Insulators	308	680	50	80	1100	639	315	104	40	-	-	3316
Ironworkers	1548	1550	300	280	5200	3267	1500	750	350	-	-	14745
Labourers	8392	6800	800	1150	24000	27279	4000	1850	1000	200	300	75771
Millwrights	250	400	87	130	2000	1005	385	45	100	-	6	4408
Operating Engineers	9891	5600	200	800	11000	12616	450	1500	600	75	300	43032
Painters	2072	1025	200	260	2000	3441	200	750	150	-	-	10098
Pipefitters	3800	4388	1000	950	11600	6850	1200	850	900	140	-	31678
Sheet Metal	2162	1800	350	630	5000	3697	250	550	300	30	-	14769
Teamsters	8395	950	30	300	5210	6073	-	100	400	-	150	21608
	55411	35331	5373	7228	99664	97459	11900	10749	7190	885	931	332121
Total Construction Force	78000	92000	26000	24000	219000	118000	18000	25000	16000	4000	-	620000
Total Union Construction Force	55411	35331	5373	7228	99664	97459	11900	10749	7190	885	931	332121
Total Non-Union Construction Force	22589	56669	20627	16772	119336	20541	6100	14251	8810	3115	(931)	287879

Source: Confidential.

Table II-2

Distribution of Construction Occupations
According to Their Industry of Employment
Canada, 1971

Occupation	CONSTRUCTION INDUSTRY: General Trade Contractor (1) No. of Employees	As % of (4)	Special Trade Contractor (2) No. of Employees	As % of (4)	Total Construction Industry (3) No. of Employees	As % of (4)	Col. %	Total All Industries (4) No. of Employees	Col. %
Excavating, Grading, Paving	33,650	39.9	7,830	9.3	41,475	49.2	11.7	84,370	14.8
Electrical Power, Light, Wire Communications	3,970	39.8	29,190	29.2	33,160	33.2	9.3	99,815	17.6
Other Construction Trades	130,930	34.1	149,755	39.0	280,690	73.0	79.0	384,380	67.6
Carpenters	42,645	42.6	29,280	29.2	71,920	71.8	20.2	100,190	17.6
Brick & Stone Masons & Tile Setters	4,285	22.4	12,045	62.9	16,330	85.2	4.6	19,160	3.4
Concrete Finishers	2,565	39.5	2,740	42.2	5,310	81.8	1.5	6,495	1.1
Plasterers	1,290	12.2	8,550	80.9	9,845	93.2	2.8	10,565	1.9
Painters & Paperhangers	1,875	5.0	22,760	60.3	24,635	65.2	6.9	37,755	6.6
Insulators	285	8.1	2,390	67.6	2,675	75.7	0.8	3,535	0.6
Roofers	345	5.4	5,260	82.8	5,605	88.3	1.6	6,350	1.1
Pipefitters & Plumbers	4,550	10.2	23,465	52.4	28,020	62.5	7.9	44,815	7.9
Structural Metal Erectors	1,785	28.6	1,330	21.3	3,115	49.9	0.9	6,245	1.1
Glaziers	60	2.4	845	33.2	900	35.4	0.3	2,545	0.4
Other	71,245	48.6	41,090	28.0	112,335	76.6	31.6	146,725	25.8
TOTAL CONSTRUCTION OCCUPATIONS	168,550	29.6	186,775	32.8	355,325	62.5	100.0	568,560	100.0

Source: Census of Canada, unpublished data.

of the other industries (Table II-3). Unfortunately, no information is available to determine whether the current pattern is similar to that of 1971.

Among the provinces, Nova Scotia, Saskatchewan and Alberta compile estimates of the future supply of skilled trades, based largely on the numbers of apprentices being trained. Planners of the mega projects also compile extensive estimates of supply in relation to the overall demand associated with the major projects.

Additions

There are several ways whereby additions can be made to the current supply of skilled workers in the construction industry. These include graduates from training programs, inter-occupational and inter-industry mobility, and immigration. In addition, geographical mobility can be used to add to the stock of a particular trade, but at the expense of another region. Similarly, mobility of workers between different types of construction (e.g., residential to commercial) will represent additions to the receiving sector.

Training

Three main types of training are used to provide qualified workers to the construction industry. They are apprenticeship, institutional training and on-the-job training.

a) Apprenticeship

Apprenticeship is the normal route for those wishing to become journeymen in the highly skilled trades such as electricians, plumbers and pipefitters. The normal training period is four years for these highly skilled trades and slightly less for the less highly skilled. The apprentice works under the guidance of a journeyman and also attends school for approximately 10 weeks per year. Thus, although the apprentices are in training and although their productivity

Table II-3

Major Industries of Employment Besides Construction
for Construction Occupations
Canada, 1971

Occupation	Industry of Employment	No. of Employees	Per Cent of Employees in All Industries
Excavating, Grsding, Paving	Transportation, Communications	25,820	30.6
Electrical Power, Light, Wire Communications	Transportation, Communications	39,970	40.0
Carpenters	Manufacturing	10,755	10.7
Brick and Stone Masons and Tile Setters	Manufacturing	1,645	8.6
Concrete Finishers	Manufacturing	580	8.9
Plasterers	Manufacturing	300	2.8
Painters and Paperhangers	Manufacturing	3,900	10.3
Insulators	Manufacturing	590	16.7
Roofers	Manufacturing	405	6.4
Pipefitters and Plumbers	Manufacturing	7,555	16.9
Structural Metal Erectors	Manufacturing	2,240	35.9
Glaziers	Manufacturing	820	32.2

Source: Census of Canada, unpublished data.

may not be as high as the journeyman's, they are still an integral part of the construction labour force. Like journeymen they, too, are subject to lay-offs.

A forecast of the future supply of graduates from apprenticeship programs in selected trades is presented in Table II-4. In the period 1975-79 some trades, such as electricians and plumbers, have shown steady increases in the number of completions, while other trades, such as steamfitters, have been erratic. The projections exhibit great year-to-year fluctuations and should be used with caution.

The trends in total enrollment and graduations for the years 1974-75 to 1978-79 show the instability of enrollments, cancellations and graduations (Table II-5). Graduations increased by over 75 per cent during this period, whereas total and new registrations declined after some periodic increases. The number of new registrations per year is heavily influenced by the general economic condition of the industry. There is little incentive to create new places for apprentices in periods of low demand for construction and uncertainty about future demand trends.

The trends from 1974-75 to 1978-79 for three provinces - British Columbia, Alberta and Ontario - are presented in Chart II-1. While completions in all three provinces are on the increase, they are subject to year-to-year fluctuations. Starts have declined considerably in British Columbia and Ontario since 1975-76 and 1976-77 respectively. However, in Alberta, in expectation of the high demand anticipated because of the mega projects, the number of starts have increased dramatically.

A summary of the enrollment, cancellation and completion pattern for all the apprenticeable construction trades for the year 1979 is presented in Table II-6. This table, in addition, shows the number of journeyman certificates granted, including those who received the Interprovincial Seal (Red Seal) that

Table II-4

Actual and Projected Number of Completions
from Apprenticeships in Selected Construction Occupations
Canada, 1975-1982+

	COMPLETIONS							
Occupation	1975	1976	1977	1978	1979	1980*	1981*	1982*
Bricklayer	69	117	125	156	193	269	247	173
Carpenter	609	950	1028	1447	1581	2019	2204	1548
Construction Electrician	1428	1580	1770	1939	2301	2609	2437	2378
Millwright	n.a.	n.a.	457	779	773	n.a.	n.a.	n.a.
Ironworker	117	97	114	178	205	190	98	90
Painter and Decorator	45	72	91	73	87	126	98	84
Plumber	734	846	886	921	985	1283	1344	1129
Roofer	19	25	21	30	41	24	32	23
Sheet Metal Worker	384	360	452	437	418	488	521	431
Steamfitter	278	319	221	289	248	461	306	313
Welder	252	424	561	725	670	824	771	740

+ Does not include data on Québec.

* ESTIMATED: On the basis of historical enrollment completion patterns probably considerably on the high side for the 1980s for all above occupations except ironworkers, painters, plumbers, roofers.

Source: Canada Employment and Immigration Commission, unpublished data.

Table II-5

CONSTRUCTION INDUSTRY APPRENTICESHIP STATISTICS

Canada, 1974-75 to 1978-79

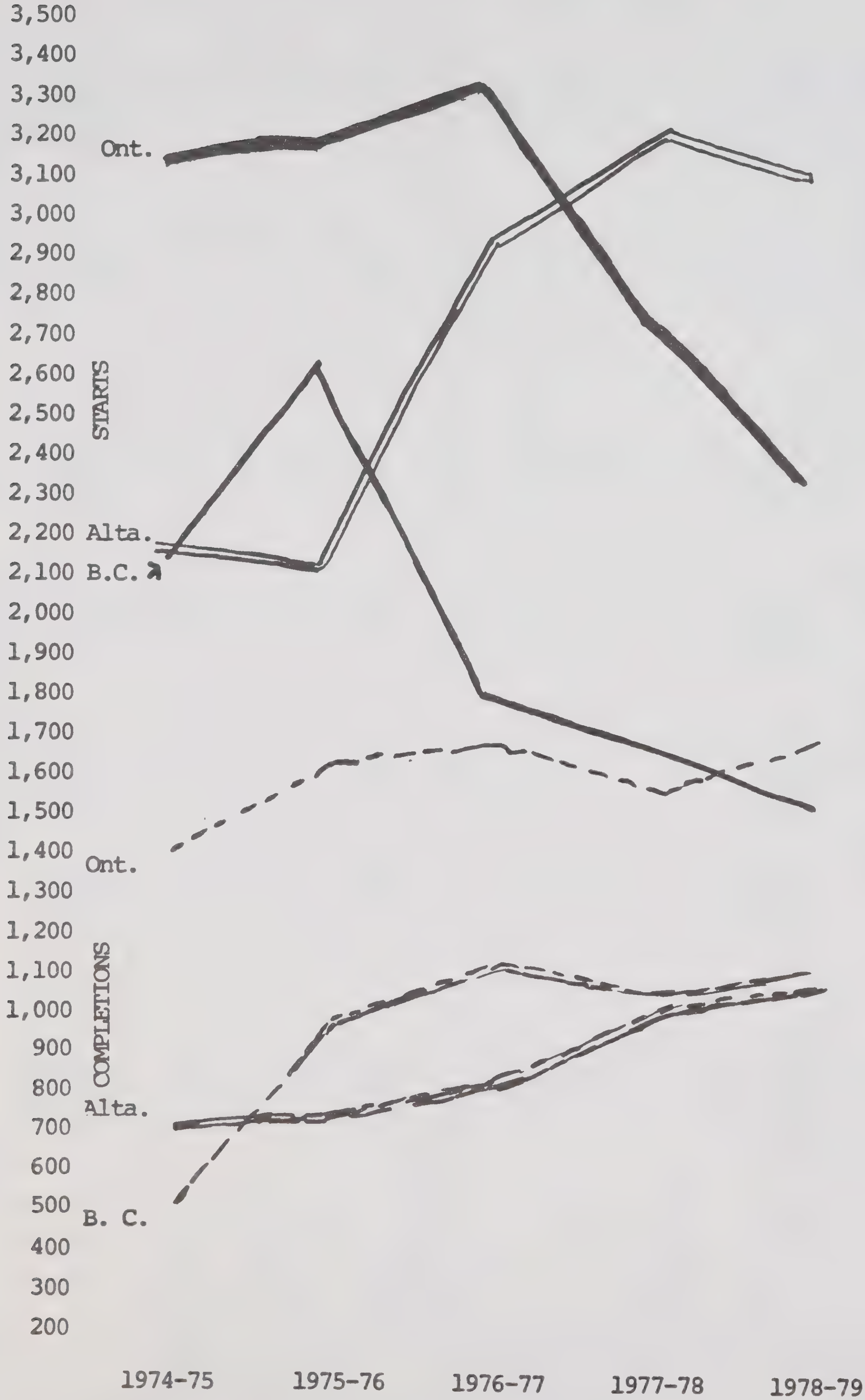
*TOTAL CANADA

	1974-75	1975-76	1976-77	1977-78	1978-79
Total Registrations	43,458	45,150	40,302	42,888	42,111
New Registrations	12,771	14,897	13,096	10,800	12,812
Cancellations	4,152	4,217	5,004	3,693	6,576
Graduations	4,551	5,534	6,639	6,378	8,047

* Without Quebec

Source: Canada Employment and Immigration Commission, Course Assessment & Improvement.

Chart II-I
Starts and Completions of Construction Apprentices in Ontario, Alberta and British Columbia, 1974-75 to 1978-79



B.C. Starts - no statistics available for 1977-1978

Source: Canada Employment and Immigration Commission, Unpublished data.

Table II-6

SUMMARY OF STATISTICS ON REGISTERED APPRENTICESHIP TRAINING

1979 CALENDAR YEAR

	Number of Apprentices					Certificates Granted	
	Already Registered on January 1, 1979	Added During 1979	Who Discontinued During 1979	Who Completed During 1979	Still Registered on December 31, 1979	With Interprovincial Seal	Without Interprovincial Seal
1. Trades with Interprovincial Standards Examination							
Boilermaker	318	159	15	121	341	110	1,382
Bricklayer	1,410	451	278	191	1,392	163	119
Carpenter	9,721	3,451	1,562	1,578	10,032	1,255	1,249
Construction Electrician	11,073	3,467	983	2,301	11,256	2,379	1,118
Heavy Duty Equipment Mechanic	4,025	1,799	568	891	4,545	948	817
Industrial Electrician	1,739	587	116	396	1,814	255	254
Industrial Instrument Mechanic	371	168	32	98	409	113	115
Industrial Mechanic (Millwright)	2,755	1,207	186	620	3,156	618	701
Lineman	594	123	31	157	529	130	90
Painter and Decorator	652	215	128	86	653	100	555
Plumber	5,954	1,793	631	932	6,184	951	651

Table II-6 (Continued)

	Number of Apprentices					Certificates Granted	
	Already Registered on January 1, 1979	Added During 1979	Who Discontinued During 1979	Who Completed During 1979	Still Registered on December 31, 1979	With Interprovincial Seal	Without Interprovincial Seal
Refrigeration and Air Conditioning Mechanic	1,054	372	94	176	1,156	123	181
Sheet Metal Worker	2,794	980	328	401	3,045	370	321
Sprinkler System Installer	371	64	34	113	288	-	171
Steamfitter-Pipefitter	1,494	417	98	248	1,565	342	422
2. Trades without Interprovincial Standards Examination							
Boilermaker	20	5	-	8	17	-	-
Bricklayer	16	8	1	2	21	-	-
Carpenter	13	14	2	3	22	-	-
Cement Finisher	50	23	9	6	58	-	-
Construction Lineman	149	32	28	27	126	-	9
Draftsman	59	29	5	20	63	-	6
Electrician (Misc.)	1,083	351	63	251	1,120	-	201
Electronics (Industrial)	88	34	12	30	80	-	12
Floorcovering Installer	209	69	75	36	167	-	19
Glazier	461	192	93	56	504	-	28
Heavy Duty Equipment Operator	12	48	7	-	53	-	42
Industrial Instrument Mechanic	45	16	1	13	47	-	-

Table II-6 (Continued)

	Number of Apprentices					Certificates Granted	
	Already Registered on January 1, 1979	Added During 1979	Who Discontinued During 1979	Who Completed During 1979	Still Registered on December 31, 1979	With Interprovincial Seal	Without Interprovincial Seal
Industrial Mechanic (Millwright)	526	254	54	153	576	-	71
Insulator	330	147	48	53	376	-	43
Ironworker	796	324	115	205	800	-	210
Lather	160	71	40	28	163	-	17
Metal Work	31	47	5	12	61	-	-
Operating Lineman	-	-	-	-	-	-	-
Painter and Decorator	1	2	-	1	2	-	-
Plasterer	267	145	59	50	303	-	8
Plumber	261	122	12	53	318	-	-
Refrigeration and Air Conditioning	13	5	1	4	13	-	1
Roofer	222	134	69	41	246	-	59
Sheet Metal Worker	39	17	-	17	40	-	-
Steamfitter-Pipefitter	3	13	5	-	11	-	-
Steel Worker (Misc.)	397	194	73	57	460	-	2
Tile Setter	84	40	14	16	94	-	13
Welder	2,394	1,245	286	670	2,683	-	1,320

allows the journeyman to work in other provincial jurisdictions.

For many trades the net increase in enrollment from year to year is not large. The starts are partially offset by the number of apprentices who have discontinued their training. For instance, the ratio of drop-outs to starts for carpenters was almost 1:2 and for pipefitters almost 1:4. Fortunately not all discontinuances are permanent, but are due to some apprentices having to find temporary employment in other occupations during layoffs in the construction industry. This high degree of instability makes it difficult to forecast future completions.

Because of the four to five years needed to train journeymen, it is not possible to adjust the supply quickly to changes in demand. Although the apprentices are working on the job, they are only partial substitutes for journeymen particularly during their first two to three years of apprenticeship.

b) Institutional

The CEIC's major support for institutional training is the Canada Manpower Training Program (CMTP). The CMTP is used extensively by the construction industry for support of its skill and apprentice training. This training is usually offered in a community college or the equivalent. Although the maximum length of the courses taken per trainee is 52 weeks of full-time or 1,820 hours of part-time instruction, workers may take more courses in subsequent years. In 1979-80 there were 48,033 training places purchased throughout Canada for 2,996 courses at a total cost of approximately $53 million (Table II-6a). The amount spent was about the same as in 1978-79 and the average duration of the training was 46 days per trainee. The table shows the heavy relative investment in training occurring in Alberta.

Table II-6a

CANADA MANPOWER TRAINING PROGRAM

Courses Related to the Construction Industry*

1979-80

Provinces and Territories	Number of Courses	Places Purchased	Average Days Duration	Total Training Days	Total Cost $
Newfoundland	215	1,706	51	87,098	2,059,134
Prince Edward Island	29	332	34	11,176	206,266
Nova Scotia	134	1,821	49	89,466	2,061,590
New Brunswick	207	2,178	65	140,874	3,314,152
Quebec	229	3,319	48	160,727	4,132,421
Ontario	712	13,365	58	781,185	18,269,124
Manitoba	202	2,867	43	122,762	2,817,592
Saskatchewan	208	2,702	36	98,281	2,670,716
Alberta	512	14,631	33	481,708	10,894,587
Northwest Territories	107	313	35	11,102	450,181
British Columbia	427	4,692	44	205,783	5,832,031
Yukon	14	107	89	9,564	355,910
CANADA	2,996	48,033	46	2,199,726	53,063,704

* Includes CCDO's 811, 814, 815, 833, 853, 859, 871, 873, 878, 879, 917

Source: Canada Employment and Immigration Commission, Training Branch, Program Analysis and Information Directorate.

Within the construction industry there is much less concern about the future supply of lower and middle level skilled occupations than the highly skilled ones. Since the training times are so much shorter and availability of programs is extensive, the time needed to react to shortages or surpluses of supply in these occupations is also much less. There is, too, less fear of over supply since the low level of skills usually can be used in other industries as well.

c) On the Job

Other than for apprenticeship, formalized on-the-job training in the construction industry is used primarily for lower skilled trades. Also in some sectors of the industry, principally residential construction and some tasks in non-union construction, it may be possible to move from lower to higher skilled occupations by learning from on-the-job experience plus a combination of formal and informal training. This route has been available for some time to those who have switched to construction occupations after working in the maintenance and repair departments in other industries.

The construction industry does not consider the training of lower skilled workers through short duration training programs a major problem in times of shortages. In fact, most major contractors, particularly those who are involved internationally in building large-scale industrial projects, have developed very sophisticated training plans for such occasions.

On-the-job training in construction is supported heavily by the Canada Manpower Industrial Training Program (CMITP). The CMITP is used to much less extent by the construction industry than CMTP. Training is provided by the employer with the latter receiving from CEIC a proportion of the cost of the trainee's wages and other training costs. Training can be given on the job, in a classroom and in a special training area. In 1979-80, the construction industry had 8,625 trainees involved in a total of 4,497 courses offered under CMITP (Table II-6b). The total

Table II-6b

CANADA MANPOWER INDUSTRIAL TRAINING PROGRAM

Courses Related to the Construction Industry*

(1979-80)

Provinces and Territories	Total Number of Contracts	Contracted Trainees	Average Days Duration	Total Days Duration	Contracted Cost $
Newfoundland	74	157	44	6,964	152,673
Prince Edward Island	70	114	86	9,814	199,895
Nova Scotia	260	563	84	47,275	919,439
New Brunswick	198	628	72	45,013	1,233,175
Quebec	549	1,405	53	74,536	1,943,225
Ontario	1,823	2,560	71	182,643	5,489,912
Manitoba	122	334	67	22,282	527,256
Saskatchewan	299	580	84	48,785	1,408,952
Alberta	285	1,087	45	48,380	1,592,212
Northwest Territories	40	123	78	9,655	342,921
British Columbia	750	1,020	67	68,316	2,068,901
Yukon	27	54	53	2,852	87,863
CANADA	4,497	8,625	66	566,515	15,966,424

* Includes CCDO's: 811, 814, 815, 833, 853, 859, 871, 873, 878, 879, 917

Source: Canada Employment and Immigration Commission, Training Branch, Program Analysis and Information Directorate.

contract cost was approximately $16 million, up from $10.3 million the previous year.

A recent initiative in on-the-job training by CEIC may become very important to the construction industry in solving the problem of shortages in the highly skilled trades. This program is Critical Trade Skills Training (CTST). CTST is similar to CMITP in that both fund industry-based training for workers by subsidizing trainees' income and the costs of training. CTST, however, concentrates on skills requiring longer and technically more sophisticated training, whereas CMITP addresses itself much more to the lower skill levels and to job entry qualifications. CTST support is for one to two years training.

Mobility

a) Geographic

Geographic mobility is essential in Canada to alleviate shortages in supply. It involves intra-provincial and inter-provincial mobility, as well as movement from project to project within a region. For the certified trades, however, inter-provincial mobility is possible only for those tradesmen having the Red Seal certification mentioned earlier.

The federal government encourages geographic mobility through its Canada Manpower Mobility Program (CMMP). The total budget allocation for this program in fiscal year 1980-81 was $9 million, down considerably from the 1979-80 allocation of $13,306,000. In the latter period, however, actual expenditures were only $9,568,161 for a total of just under 32,000 grants. In 1979-80, the number of grants to the construction industry was 1,063 and between April 1 and December 13, 1980 this number reached 861.

In the period between April 1 and December 31, 1980 the majority of grants to the construction industry were for

permanent relocation (Table II-7a). Grants for temporary employment and for employment exploration followed in that order. Grants for student mobility amounted to less than one per cent of the total. However, the above pattern did not prevail to the same extent or in the same order when viewed in each of the originating provinces. For instance, exploratory grants were more numerous than temporary employment grants in all regions other than the Atlantic. The same general order prevailed in 1979-80, but the percentages were different: relocation, 36%; temporary, 34%; and exploratory, 31%.

The geographical patterns vary considerably, depending on the originating province of the grant recipient (Table II-7b). A majority of those from all provinces except Alberta and British Columbia do not remain within their home province. Half of the grant recipients from Newfoundland and all of those from the provinces in the Western Region remain within their home region. In all other provinces of origin, the majority of grant recipients went outside their home region. Alberta was a major destination for the grant recipients with 40% of those from the Atlantic Region, and 60% of those from Ontario going to Alberta under the CMMP. The Atlantic Region was the largest originating region for 409 or 48% of the grants, while the Western Region was the largest receiving region with 572 grants or 66% of the total. There is a very definite east to west flow in terms of mobility.

The vast majority of grants went to recipients who were working for special trade contractors (51%) and building trade contractors (35%) (Table II-7c). There were some differences by originating region. For instance, the percentage of those receiving grants who were working for special trade contractors was much higher in the Western Region and Quebec than elsewhere, and in the Atlantic Region the percentage of those working for

Table II-7a

Number and Percentage Distribution of Canada Manpower Mobility Grants
To the Construction Industry
By Category of Grant and Originating Province
April-December, 1980

Province From Which Grant Recipient Moved

Category of Grant	Nfld.	N. S.	N. B.	P.E.I.	Atlantic Region	Que.	Ont.	Man.	Sask.	Alta.	B. C.	Yukon & NWT	Western Region	TOTAL
Relocation	99	45	78	7	229	66	197	16	10	10	29	3	68	560
Exploratory	10	7	13	2	32	31	38	6	4	0	5	3	18	119
Temporary Employment	100	22	23	0	145	14	9	1	1	1	3	1	7	175
Seasonal Agric.	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Special Travel	1	1	0	0	2	0	0	0	0	0	0	0	0	2
Student Mobility	0	0	0	1	1	0	1	0	0	0	1	0	1	3
TOTAL	210	75	114	10	409	111	247	23	15	11	38	7	94	861

Percentage Distribution

Category of Grant	Nfld.	N. S.	N. B.	P.E.I.	Atlantic Region	Que.	Ont.	Man.	Sask.	Alta.	B. C.	Yukon & NWT	Western Region	TOTAL
Relocation	47.1	60.0	68.4	70.0	56.0	59.5	79.8	69.6	66.7	90.9	76.3	42.9	72.3	65.0
Exploratory	4.8	9.3	11.4	20.0	7.8	27.9	15.4	26.1	26.7	0	13.2	42.9	19.1	13.8
Temporary Employment	47.6	29.3	20.2	0	35.5	12.6	3.6	4.4	6.7	9.1	7.9	14.3	7.4	20.3
Seasonal Agric.	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0.2
Special Travel	0.5	1.3	0	0	0.5	0	0	0	0	0	0	0	0	0.2
Student Mobility	0	0	0	10.0	0.2	0	0.4	0	0	0	2.6	0	1.1	0.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Canada Employment and Immigration Commission, special tabulation.

Table II-7b

Number and Percentage Distribution of Canada Manpower Mobility Grants
To the Construction Industry by Originating and Receiving Provinces
April-December, 1980

Receiving Province

Originating Province	Nfld.	N. S.	N. B.	P.E.I.	Atlantic Region	Que.	Ont.	Man.	Sask.	Alta.	B. C.	Yukon & NWT	Western Region	TOTAL	(1)	(2)	(3)
Newfoundland	100	3	2	0	105	4	16	4	1	67	7	6	85	210	47.6	50.0	31.9
Nova Scotia	0	7	0	0	7	0	7	6	1	29	25	0	61	75	9.3	9.3	38.7
New Brunswick	2	1	2	1	6	3	8	21	8	60	7	1	97	114	1.8	5.3	52.6
Prince Edward Island	0	0	0	0	0	0	1	1	0	8	0	0	9	10	.0	.0	80.0
Atlantic Region	102	11	4	1	118	7	32	32	10	164	39	7	252	409	-	28.9	40.1
Quebec	1	0	0	0	1	46	17	1	3	33	7	3	47	111	41.4	41.4	29.7
Ontario	2	3	1	0	6	1	60	4	4	143	27	2	180	247	24.3	24.3	57.9
Manitoba	0	0	0	0	0	0	0	3	4	11	5	0	23	23	13.0	100.0	47.8
Saskatchewan	0	0	0	0	0	0	0	0	5	8	2	0	15	15	33.3	100.0	53.3
Alberta	0	0	0	0	0	0	0	0	0	6	5	0	11	11	54.5	100.0	.0
British Columbia	0	0	0	0	0	0	0	0	0	13	24	1	38	38	63.2	100.0	34.2
Yukon & NWT	0	0	0	0	0	0	1	0	0	0	0	6	6	7	85.7	85.7	.0
Western Region	0	0	0	0	0	0	1	3	9	38	36	7	93	94	-	99.0	40.4
	105	14	5	1	125	54	110	40	26	378	109	19	572	861			

(1) % of total who remain in home province.

(2) % of total who remain in home region.

(3) % of total who moved to Alberta or within Alberta.

Source: Canada Employment and Immigration Commission, special tabulation.

Table II-7c

Number and Percentage Distribution of Canada Manpower Mobility Grants
To the Construction Industry
By Type of Contractor and Originating Province
April-December, 1980

NUMBER
Originating Province

Type of Contractor	Nfld.	N. S.	N. B.	P.E.I.	Atlantic Region	Que.	Ont.	Man.	Sask.	Alta.	B. C.	Yukon & NWT	Western Region	TOTAL
*SIC 404	100	22	50	1	173	23	83	6	3	1	9	6	25	304
406	19	1	4	0	24	5	18	1	1	2	3	0	7	54
409	13	25	8	0	46	8	10	1	0	0	2	0	3	67
421	78	27	52	9	166	75	136	15	11	8	24	1	59	436
TOTAL	210	75	114	10	409	111	247	23	15	11	38	7	94	861

PERCENTAGE DISTRIBUTION
Originating Province

Type of Contractor	Nfld.	N. S.	N. B.	P.E.I.	Atlantic Region	Que.	Ont.	Man.	Sask.	Alta.	B. C.	Yukon & NWT	Western Region	TOTAL
SIC 404	47.6	29.3	43.9	10.0	42.3	20.7	33.6	26.1	20.0	9.1	23.7	85.7	26.6	35.3
406	9.0	13.3	3.5	.0	5.9	4.5	7.3	4.3	6.7	18.2	7.9	.0	7.4	6.3
409	6.2	33.3	7.0	.0	11.2	7.2	4.0	4.3	.0	.0	5.3	.0	3.2	7.8
421	37.1	36.0	45.6	90.0	40.6	67.6	55.1	65.2	73.3	72.7	63.2	14.3	62.8	50.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*SIC 404 - Building Contractor.
406 - Highway, Bridge and Street Contractors.
409 - Other Construction, Dams, Utilities.
421 - Special Trade Contractors.

Source: Canada Employment and Immigration Commission, special tabulation.

special trade contractors and receiving grants was almost the same as for those working for general building contractors.

Whether workers actually go from one geographic location to another depends on potential economic returns, living conditions, sociological variables, availability of suitable work at home, et cetera.

For the major industrial projects of two to three years duration, it is estimated that two workers will be needed in addition to each worker on the job for each tradesman's position. For mega projects, such as Syncrude, the ratio was 3:1, with the majority of workers being non-local.

While geographic mobility can help solve problems of supply for the area that is in a shortage situation, it can create potential or actual problems in the areas from which they have migrated. For instance, Manitoba, currently in a period of depressed construction demand, is seeing its tradesmen leaving the province for the 'green pastures' of Alberta. There is some concern in Manitoba construction circles that should conditions in the province improve, they might not get their migrants back and might face shortages themselves. The Maritime Provinces, which have had some tradesmen move to Alberta, feel that there would be no problem attracting their workers back should demand increase sufficiently.

b) Inter-occupational and Inter-industrial

Though little research has been done on inter-occupational or inter-industry mobility, given suitably high levels of demand and sufficient incentives, workers can be expected to move to the construction industry from other industries and occupations and to shift within the industry. Shifts can take place, too, from construction to other industries. It is estimated that those with lower and middle-level skills who became unemployed when new residential construction declined in the late 1970s have shifted to jobs in other industries.

An indication of the extent and frequency of inter-industry mobility occurring in Canada is revealed from data extracted from CEIC records. The Longitudinal Data File gives one of the very few opportunities to explore mobility into and out of the construction industry over an extended period of time; this source deserves much more attention by CEIC researchers.[1]

From the Longitudinal Data File a random sort was done of persons using the programs of the CEIC (e.g., unemployment insurance, CMTP, and CMITP) with social insurance numbers based on residence in Nova Scotia at time of issuance. They had worked at least once in the construction industry between the years 1972 and 1978 inclusive and had filed T-4 supplementary forms during that time. This analysis looked only at industry of employment but took no account of the job function or occupation in which the employee was engaged; presumably some of those workers could perform similar functions or occupations but in different industries. It is expected that the majority of workers included in this sample are in the low or medium-skill levels. Because there is strong likelihood construction workers will become unemployed at least once during a period of five years or more, due among other reasons to the seasonal and cyclical nature of the industry, there is a high probability that a large proportion of construction workers will be included in this data file.

Table II-8 shows the extent and frequency of mobility of personnel among the major industry divisions over a seven-year period. Considerable change occurs not only from year to year, but also within the year. Workers normally employed in other industries flow into construction for a short period of employment. Likewise construction workers find employment outside this

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1/ For further information on job histories and inter-industry mobility of workers who have received benefits under the CEIC unemployment insurance program, see the study commissioned by the Labour Market Development Task Force: The Characteristics of Unemployment in Canada, by Glen P. Jenkins and Graham Glenday.

Table II-8

Labour Mobility Into and Out of the Construction Industry
1972 - 1978

Year	No. of T-4 Supp'y. Filed or Equivalent	Number of Workers Who Filed A T-4 Supplementary or Equivalent in SIC DIVISION* 6	1	2	3	4	5	7	8	9	10	11	12
1972	1	30	1	2	3	1	7	8	11	1	5	8	23
	2	33	0	2	2	1	10	7	10	1	5	7	23
	3	32	1	1	3	1	9	8	7	1	8	7	23
	4	31	0	1	2	2	12	7	7	1	9	7	23
1973	1	21	0	2	1	2	10	7	8	3	11	4	31
	2	28	0	2	2	2	8	7	7	1	7	5	31
	3	23	0	2	2	2	11	8	10	1	4	6	31
	4	22	1	2	1	2	13	7	10	1	3	6	32
1974	1	29	3	2	2	1	10	4	6	3	3	6	34
	2	26	2	2	3	1	10	4	8	2	3	8	33
	3	25	1	2	3	2	9	4	7	1	3	10	33
	4	22	2	4	3	1	11	4	8	1	1	11	33
1975	1	23	1	0	1	1	11	5	6	7	4	8	31
	2	21	0	0	1	1	10	5	10	5	3	11	31
	3	21	0	0	1	1	7	5	9	6	3	15	31
	4	23	0	0	0	1	7	2	9	6	5	14	31
1976	1	24	1	0	5	1	11	2	9	2	3	9	33
	2	30	0	0	4	1	8	2	9	1	3	9	33
	3	32	0	1	3	1	8	2	8	1	3	8	33
	4	29	0	1	3	1	6	3	10	3	3	9	32
1977	1	25	0	0	2	1	6	1	9	0	9	14	33
	2	29	0	0	1	1	4	1	8	0	9	14	33
	3	28	0	0	1	1	4	1	6	0	9	15	34
	4	27	0	0	2	0	4	2	7	1	9	13	34
1978	1	20	0	0	2	0	8	3	7	1	9	12	38
	2	23	0	0	2	1	7	2	7	2	7	12	37
	3	24	0	0	3	0	6	3	6	2	7	12	37
	4	25	0	0	3	1	5	3	8	1	5	12	37

* See following page for names of divisions. All rows total 100.

Source: CEIC, unpublished data from Longitudinal Data File.

Note for Table II-8

Standard Industrial Classification (SIC) Listing

Number of Division	Industry Title
6	Construction
1	Agriculture
2	Forestry
3	Fishing and Trapping
4	Mining (including Milling), Quarries and Oil Wells
5	Manufacturing
7	Transportation, Communications and Other Utilities
8	Trade
9	Finance, Insurance and Real Estate
10	Community, Business and Personal Services
11	Public Administration and Defence
12	Unspecified

industry for varying lengths of time. Other workers flow in and out of many industries without having a strong tie to any one in particular. The highest and lowest percentage of workers employed in the construction industry at any given points in time were 33 per cent and 20 per cent respectively. Construction employed more workers than any other industry with community/business/personal services and manufacturing following in second and third positions.

Construction employment was highest during 1972 and lowest during 1975.

The flows into and out of the construction industry, as demonstrated in Table II-8, show some of the difficulties defining the population and composition of the construction labour force. Regular and frequent reporting on these changes is needed to provide adequate monitoring of the supply.

c) <u>Inter-sectoral</u>

Shifts are also possible among the same sectors of the construction industry. Limited mobility is possible between building and engineering construction but, within these two sectors, considerable movement can take place. Possibilities may exist between high-rise residential and commercial construction and between major commercial projects and industrial, particularly for the electrical and mechanical trades. Mobility between low-rise residential and other types of construction is limited to a few trades, such as electricians, carpenters and plumbers. Some of this mobility is limited by skill requirements, while some of it is limited by union/non-union jurisdictions or legal requirements.

d) <u>Inter-functional</u>

In non-union open shops some alterations have occurred in the tasks performed by the various trades, with tasks involving similar types of skills being performed by a range of different trades. Some indication of the potential in

pursuing this type of skill/task transfer is shown in the presentation entitled "Generic Skills Potential Transferability in the Craft Trades", prepared by the Occupational and Career Analysis and Development Branch, Employment and Immigration Canada.

In the 1978 CEIC study, Generic Skills Keys to Job Performance, the need for great functional flexibility was acknowledged:

> "It is increasingly recognized that the rate of technological change, as well as the fluctuations of specific labour markets, requires a degree of training and flexibility possessed by relatively very few workers. The problem lies not in a resistance to change on the part of the labour force, but rather on the content of the curriculum which trains a person for a specific job rather than for a family of jobs, and the nature of the credentials for employment which fail to recognize, in this age of specialization, that many skills are transferable to a variety of occupations."1/

Immigration

Historically in Canada immigration, whether permanent or temporary; i.e., employment authorization, has been used to alleviate shortages of skilled personnel.

The following table (Table II-9) indicates the number of landed immigrants who entered Canada between 1975 and 1980 and whose occupation was in the construction industry. In keeping with the perceived increases in demand for the 1980s, it is interesting to note that the intake for the first half of this year was close to the levels for all of last year.

1/ See also study on generic skills training done for the Labour Market Development Task Force by Arthur DeW. Smith.

Table II-9

Intended Skilled Trades Occupations in Construction
of Landed Immigrants to Canada
1975 to 1980

Intended Occupation	1975	1976	1977	1978*	1979	Jan. to June 1980
Carpenters	1160	782	578	252	366	322
Brick and Stone Masons	652	432	392	227	147	155
Concrete Finishers	94	39	23	27	9	7
Plasterers	83	58	54	34	22	16
Painters and Paper-hangers	413	276	204	125	124	93
Insulators	6	6	6	2	3	2
Roofers	35	26	25	11	9	9
Pipefitters and Plumbers	381	262	228	140	157	142
Structural Metal Erectors	65	31	13	2	17	11
Glaziers	33	24	13	9	6	4

* Changes in reporting procedures introduced.

Source: Canada Employment and Immigration Commission, special tabulations.

Employment authorizations are issued to meet short-term needs for particular occupations. Table II-10 shows the large fluctuations that occur to meet special needs. For example, the large intakes of pipefitters were concentrated in New Brunswick in 1975 and in Ontario in 1976 and 1977.

The use of immigration as a means of meeting excess demands may be more difficult in the 1980s than in the 1970s. There seems to be much less availability of skilled trades now than in the past. With the exception of the United Kingdom, the number of skilled workers from Europe willing to work in Canada is very limited. The combination of good working conditions and high incomes at home make Canada less attractive than previously. Another factor is the wide range of alternatives available for the highly skilled workers in countries other than Canada. (See Chapter I on Canada in the World Context.)

No data are readily available on the number of skilled tradesmen who emigrate permanently or temporarily from Canada to work on construction projects abroad.

Attrition

It is estimated by the CEIC that the attrition rate for the more highly skilled construction trades in the period 1980 to 1985 will be between 2.6 per cent and 3.6 per cent (Table II-11).

Table II-10

Employment Authorizations Issued to Skilled Trades
in the Construction Industry by Intended Occupations
Canada, 1975 to 1980

Occupation	1975	1976	1977	1978	1979	Jan. to June 1980
Carpenters	757	570	212	153	202	134
Brick and Stone Masons	312	298	168	82	71	31
Concrete Finishers	74	46	34	14	14	15
Plasterers	87	79	37	27	27	20
Painters and Paper hangers	70	69	52	30	56	54
Insulators	118	64	597	18	27	14
Roofers	25	22	11	19	41	26
Pipefitters and Plumbers	4475	1832	1430	24	46	14
Structural Metal Erectors	335	141	30	25	40	11
Glaziers	12	27	13	0	6	3

Source: Canada Employment and Immigration Commission, special tabulations.

Table II-11

Attrition in Selected Construction Trades

1980 - 1985

Occupation	Average Number per year	Percentage of 1980 stock
Carpenters	3,575	3.6
Brick and Stone Masons	625	3.1
Concrete Finishers	185	3.1
Plasterers	325	2.6
Painters and Paperhangers	1,150	3.1
Insulators	125	2.7
Roofers	255	2.7
Pipefitters and Plumbers	1,475	2.9
Structural Metal Workers	250	2.8
Glaziers	160	2.7

Source: Unpublished Canada Employment and Immigration Commission guesstimate based on COFOR adjustments to take account of occupational mobility and immigration.

Demographic Changes

In the 1980s and 1990s the potential supply of young Canadians age 18 to 24 available for entry into apprenticeships is predicted to decline considerably.* From a high of approximately 3.3 million persons in 1980, this population group is predicted to decline by 0.7 million to about 2.6 million in 1992.

With the decrease in workers in the usual age-of-entry group, some changes may be necessary to meet the demand for those entering training programs in the construction trades. This might

* Apprentices usually start when they are between 22 and 24 years of age, although some enter as late as their early thirties.

include drawing entrants from younger ages; e.g., 18 to 20 - or older, 25 to 35 - or increasing the participation rate of males, or inducing females to enter the construction trades in much greater numbers than is presently the case.

Supply of Engineers

The Current Supply

Information on the stock of engineers for the construction industry should be available within a few years from the Canadian Engineering Manpower Inventory (CEMI), being developed by the Canadian Engineering Manpower Council (CEMC) of the Canadian Council of Professional Engineers (CCPE).[1] By the mid-1980s this inventory is expected to be fully operational and will include information on the stock of engineers in Quebec, Ontario, Alberta and British Columbia. It is hoped that similar data on engineers in the remaining provinces will be included shortly.

A forecasting capability has not yet been developed in conjunction with the CEMC inventory, though a substantial amount of the required raw data is currently available. University enrollment and graduation data are collected nationally by the CEMC and Statistics Canada, while information on both permanent and temporary immigration is available from CEIC. Inter-occupational mobility of non-registered engineers would need further research. From the occupational and industrial classifications identified in the inventory detail, it should be possible to develop a sub file on the numbers of engineers actually working in the construction industry and potentially available to it. This information could be an important component of the Construction Information System discussed in Chapters IV and V.

Present information on the supply of engineers is available from MOSST, TSC and CEIC, Edmonton. Neither the MOSST nor the TSC

1/ A complete description of the Inventory can be found in Engineering Manpower News, March, 1981.

has attempted to relate supply to any specific industry or to any particular type of engineering occupation. Table I-11 showed the occupation/industry combination and Table II-12, presented below, shows the education to occupation shifts as of 1971. These tables indicate that it is almost impossible to match future supply to any particular occupation ahead of time. All that is possible is to try to ensure that overall supply is sufficient in number and hope that the mix will be appropriate to meet demand.

MOSST estimates the stock of engineers in 1980 to be 75,442. The following table (Table II-13) shows membership in the Canadian Council of Professional Engineers for the 1970s. Not all members are currently working as engineers, however.

Additions

MOSST has provided information on new supply only up to 1978 and has not made detailed forecasts for the 1980s. (Table II-14).

The TSC has made projections for the years to 1990 (Table II-15). There are three growth assumptions, slow, moderate and rapid, with the moderate path being considered the most probable.

Engineering Technicians and Technologists

Engineering technicians and technologists are becoming more important in engineering as they take on many of the more routine or technical functions formerly conducted by engineers. Table II-16 shows the number of students enrolled by province. An inventory similar to the aforementioned one for engineers has not yet been developed for engineering technicians and technologists, but would be highly desirable.

Immigration

Assumptions about immigration have been included in the information presented above on additions to supply. However, this makes no reference to trends in immigration to the construction industry per se. This information for the years 1975 to 1980 is presented in Table II-17. The number of landed immigrants entering in recent years has been

Table II-12

Number of Engineers by Field of Study
1971

Field of Study

Occupations	Chem. Eng.	Civil Eng.	Elect. Eng.	Mech. Eng.	Metal. Eng.	Aero. Eng.	Mining Eng.	Petro. Eng.	Indus. Eng.	Agric. Eng.	Other Eng.	Phys. Sci/Math.	Other FOS	No Degree	Total
Chem. Eng.	1,828	58	86	199	21	2	23	31	10	4	41	237	123	494	3,157
Civil Eng.	272	9,106	459	846	54	45	289	16	62	61	524	225	1,030	2,484	15,473
Elect. Eng.	68	280	5,975	582	25	3	49	3	53	0	240	482	362	1,602	9,724
Mech. Eng.	156	289	234	4,064	33	89	59	15	56	52	133	110	176	1,484	6,950
Metal Eng.	59	25	36	48	309	0	29	5	0	0	4	41	24	96	676
Aero. Eng.	0	11	25	230	4	195	0	0	4	0	19	34	38	91	651
Mining Eng.	39	60	12	56	28	0	620	7	2	4	11	182	89	265	1,375
Petro. Eng.	152	95	30	159	4	2	91	204	0	2	29	31	23	259	1,081
Indus. Eng.	291	282	393	718	64	50	100	27	297	11	125	370	995	685	4,408
Other Eng.	157	285	203	209	30	21	30	2	37	99	150	153	687	521	2,584
Geologist	5	44	28	10	4	0	493	8	0	6	25	2,536	126	1,420	4,705
Chemists	341	39	14	6	14	4	0	0	5	11	15	2,784	1,011	2,896	7,140
Comp. Prgm.	119	134	574	195	21	45	6	0	127	8	133	2,978	2,242	15,903	22,485
Comm. Off.	129	262	363	234	0	48	22	0	32	12	114	657	1,669	12,868	16,410
Tech. Sales	131	81	214	259	21	18	9	11	3	5	9	115	282	4,787	5,945
Professor	224	325	513	301	91	54	66	3	51	28	143	4,257	18,677	0	24,733
Administrator	1,414	2,238	1,804	2,303	335	112	701	162	294	70	734	3,787	30,138	191,373	235,465
Other HQM	531	759	1,025	811	137	79	288	18	191	219	680	12,569	250,043	552,915	820,265
Non-HQM Occs.	2,026	2,505	2,903	2,998	748	148	688	113	365	281	933	12,844	99,545	6,580,372	6,706,469
TOTAL	7,942	16,878	14,891	14,228	1,943	915	3,563	625	1,589	873	4,062	44,392	407,280	7,370,515	7,889,696

Source: MOSST - Based on 1971 Census, 1973 Post-Censal Survey and Membership Lists of the CCPE.

Table II-13

Membership in the Canadian Council
of Professional Engineers
1970-79

Dec. 31 Year	Alta.	B. C.	Man.	N. B.	Nfld.	N. S.	Ontario	P.E.I.	Quebec	Sask.	Minimum Estimate Yukon	Total
1970	6,710	6,259	1,776	872	445	1,378	30,997	65	13,955	1,496	146	64,099
1971	7,219	6,467	1,841	919	515	1,457	32,134	64	14,604	1,492	141	66,853
1972	7,727	6,854	1,917	998	548	1,639	33,714	71	15,242	1,454	197	70,361
1973	8,550	7,376	2,014	1,080	593	1,691	35,591	80	15,659	1,505	210	74,349
1974	9,147	7,696	2,041	1,167	661	1,807	37,155	87	16,909	1,605	210	78,485
1975	9,704	8,239	2,340	1,264	760	1,893	39,314	89	17,986	1,784	211	83,583
1976	10,770	8,525	2,331	1,403	809	1,829	41,833	89	19,534	1,867	210	89,200
1977	12,058	8,917	2,459	1,486	838	1,996	44,669	97	20,565	2,094	211	95,390
1978	13,003	9,157	2,541	1,522	917	2,091	44,961	124	21,251	2,263	211	98,035
1979	14,470	9,556	2,546	1,575	934	2,069	45,565	132	21,893	2,193	211	101,144

Source: Canadian Council of Professional Engineers Association Membership.

Table II-14

Analysis of Supply of Engineering Graduates
(All Degree Levels)

		1972	1973	1974	1975	1976	1977	1978	1979
	Degrees Awarded	5,443	5,416	5,339	4,917	5,252	5,749	6,337	7,078
Less:	Part-time Graduates	136	161	178	168	173	215	233	-
	Foreign Graduates Returning Home	641	678	684	640	720	785	845	-
	Graduates Continuing Education	937	853	788	727	789	805	860	-
Equals:	Available Domestic Supply	3,729	3,724	3,689	3,382	3,570	3,944	4,399	-
Add:	Canadians Returning From Abroad	393	391	379	332	360	401	443	-
	Immigrants	1,700	2,071	2,185	2,055	1,744	1,357	1,463	-
Equals:	Adjusted Supply	5,822	6,186	6,253	5,769	5,674	5,702	6,305	-

(-) Indicates data not available.

Source: MOSST, "Recent Trends in Degrees Awarded and Enrollments at Canadian Universities", Background Paper No. 16, Appendix B, August 1980.

Table II-15

Projected Supply of Engineers
Canada, 1980 - 1990
(Moderate Growth Assumption)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Net Supply	3814	4038	4259	4482	4419	4631	4515	4425	4402	4314	4461
Immigration	300	300	300	300	300	300	300	300	300	300	300
Total Supply at First Degree Level	4114	4338	4559	4782	4719	4931	4815	4725	4702	4614	4761
Total Supply at Graduate Level	701	714	727	740	753	766	779	791	803	816	826
TOTAL SUPPLY	4815	5052	5286	5522	5472	5697	5594	5516	5505	5430	5587

Source: Technical Services Council, Supply of and Demand for Engineers - Canada, Toronto, 1980, Tables 4:1 and 4:2.

Table II-16

Enrollment in Engineering Technology Programs
in Canada, 1977-78 and 1978-79

Province	1977-78	1978-79	Difference
British Columbia	1,883	1,979	5.1
Alberta	2,934	3,259	11.1
Saskatchewan	335	429	28.1
Manitoba	663	714	7.7
Ontario*	6,918	7,976	15.3
Quebec**	11,201	12,239	9.3
New Brunswick	467	553	18.4
Nova Scotia	499	476	(4.8)
Prince Edward Island	112	111	8.0
Newfoundland	263	270	2.7
TOTAL	25,275	28,006	10.8

* Includes Ryerson Polytechnical Institute
** Includes Ecole de technologie supérieure

Source: Canadian Engineering Manpower Council, Engineering Manpower News, No. 21, September 1979, p. 1.

Table II-17

Number of Engineers and Architects
Entering Canada
as Landed Immigrants and Temporary Workers
in the Construction Industry
1975 - 1980

Status	1975	1976	1977	1978*	1979	Jan. to June 1980
Landed Immigrants	217	177	104	56	54	48
Engineers and Architects Occupations related to Engineering and Architecture	81	80	68	36	52	26
Temporary Workers	165	128	66	54	63	32
Engineers and Architects Occupations related to Engineering and Architecture	158	135	128	124	188	73

* Changes in reporting procedures introduced for landed immigrant data.

Source: Canada Employment and Immigration Commission, special tabulations.

relatively small, as has the number of engineers who have received employment authorizations to work in Canada.[1]

Demographic Changes

Engineering faces the same problem as the skilled trades in the change of age structure of Canada. With the decline in the number of persons in the 18 to 24 age category during the 1980s and early 1990s, attention will have to be given to attracting a greater percentage of this age group into engineering if current enrollment levels are to be maintained.

It will be recalled, however, that in Chapter I on demand, there was a significant discrepancy between the projections of engineer requirements made by MOSST and those by TSC. MOSST indicated a drop in demand for graduates by 1985.

1/ Further information on the temporary immigration into Canada of engineers and engineering technologists, by area of specialization and by province of destination and country of origin, but not intended occupation or industry, is presented in the article "Employment Aughorizations and Foreign Worker Police", appearing in Engineering Manpower News, February 1981.

Chapter III

IMBALANCES

Skilled Trades

In the skilled trades specific imbalances căn be identified only in the three provinces that undertake to quantify demand and supply for construction manpower by occupation. On a national basis some macro projections of construction demand are for investment only and are not converted into manpower requirements. Moreover, demand projections from the Task Force are at sufficient variance with the Informetrica investment forecast as to be confusing for manpower planning purposes.

The supply side is, and will be, more difficult to measure because of the suspected movement of tradesmen in and out of the industry or sector concerned. As well, the pattern of apprenticeship completions has been quite uneven and difficult to predict due to varying opportunities to enter training and due also to withdrawals on account of layoffs or other reasons.

Nationally, substantial shortages in some skilled trades are forecast during the 1980s with the problem likely peaking around the middle of the decade and possibly again towards the end. Regionally, on the basis of data compiled at the federal or provincial government level plus detailed estimates prepared by planners of the mega projects, the shortages will be concentrated in Alberta and to a lesser extent in Saskatchewan. A recent survey of hiring difficulties suggests, however, that shortages may occur throughout the west and as far east as Quebec (Table III-1). Shortages in the Atlantic region will depend on how many large-scale projects occur within the region and how these coincide with heavy demand elsewhere.

The trades that are currently experiencing or anticipating shortages are:

*Boilermakers
Carpenters
Iron Workers
*Millwrights

Table III-1

Percentage of Construction Firms Who Are Experiencing Problems in Hiring Due to Shortages of Qualified Workers Canada and the Provinces, 1979-80

	Building Contractors	Other than Building Contractors	Special Trade Contractors	Total	Number of Firms Surveyed
Newfoundland	0	0	-	0	4
Prince Edward Island	-	-	-	-	0
Nova Scotia	-	0	-	0	1
New Brunswick	-	0	-	0	2
Quebec	0	25.00	31.58	25.93	27
Ontario	0	50.00	38.00	33.33	33
Manitoba	0	100.00	60.00	66.67	6
Saskatchewan	50.00	100.00	100.00	80.00	5
Alberta	66.67	100.00	85.71	80.00	20
British Columbia	100.00	50.00	50.00	60.00	10
Yukon/NWT	100.00	0	-	50.00	2
Canada	40.00	44.00	46.67	44.45	110

Source: Economic Council of Canada, Human Resources Survey, special tabulation.

Cement Masons	Operating Engineers
Electricians	*Pipefitters
Insulators	*Welders (pipe)

* indicates shortages that are regarded as critical and requiring specific action to alleviate; there is some indication that carpenters and electricians may also be in critical short supply.

Manpower planning for the Alsands Project Group illustrates the results to be anticipated if a number of major projects proceed concurrently and how individual trades will be affected. Though out of date because of postponement of the project, Tables III-2(a) and (b) and Chart III-1 serve to demonstrate this. It is of particular interest to note the effect scheduling of the projects would have and also the importance of being able to attract tradesmen from other parts of Canada. If major energy projects develop on the east coast, they would have, of course, a major effect on the Canadian supply/demand balance of construction trades.

Table III-3 illustrates the precise timing necessary in planning the manpower requirements of the mega projects and the importance of having the requirements of all trades on hand as needed.

In spite of the fact that the shortages and distortions in the construction labour market will be due mainly to the mega projects, it is not anticipated that they will necessarily bear the main brunt. With their huge budgets and attractive pay packages, they are expected to be able to attract skilled manpower as needed. Especially if the shortages become severe, some of the manpower will come from federal, provincial and municipal governments and the private sector and they, more than the mega projects, will suffer the consequences of the shortages. If several mega projects are planned simultaneously, however, there may not be sufficient manpower for all of them to proceed on schedule.

<u>Engineers</u>

As in the case of skilled trades, the probability of there being shortages of engineers in the construction industry depends heavily on the number and timing of the mega projects and the employment situation in other industries. According to the TSC study, the demand for newly graduated

Table III-2(a)

ALSANDS PROJECT GROUP

INDUSTRIAL ACTIVITY SCENARIOS

BASE LOAD	Small plants, plant expansions and modification within Alberta and the rest of Canada.
CASE 1	Base + Alsands
CASE 2	Base + Alsands + Cold Lake Heavy Oil
CASE 3	Base + Alsands + Cold Lake + Foothills Gas Pipeline
CASE 4	Base + Alsands + Cold Lake + Foothills Gas Pipeline + Syncrude expansion and another project valued at $500 MM.

Table III-2(b)

ALSANDS PROJECT GROUP

CONSTRUCTION LABOUR

MANUAL LABOUR SHORTFALLS

SHORTFALL UTILIZING ALBERTA LABOUR

	CASE 1	CASE 2	CASE 3	CASE 4
Pipefitters	282	1,782	2,232	2,584
Welders	20	593	1,672	1,751
Electricians	0	0	170	388
Boilermakers	167	617	663	663
Iron Workers	198	818	1,200	1,292
Millwrights	81	181	273	273
Oper. Eng.	0	1,154	2,717	2,922
Insulators	65	575	610	678
Teamsters	0	0	922	1,012
Labourers	0	200	1,242	1,432

SHORTFALL UTILIZING CANADIAN LABOUR

	CASE 1	CASE 2	CASE 3	CASE 4
Pipefitters	0	631	1,081	1,433
Welders	0	213	1,276	1,371
Electricians	0	0	0	0
Boilermakers	140	590	636	636
Ironworkers	0	142	524	616
Millwrights	67	167	259	259
Oper. Eng.	0	42	1,605	1,810
Insulators	0	478	513	581
Teamsters	0	0	922	1,012
Labourers	0	0	649	839

Chart III-1

ALSANDS PROJECT GROUP

CONSTRUCTION LABOUR
SUPPLY / DEMAND

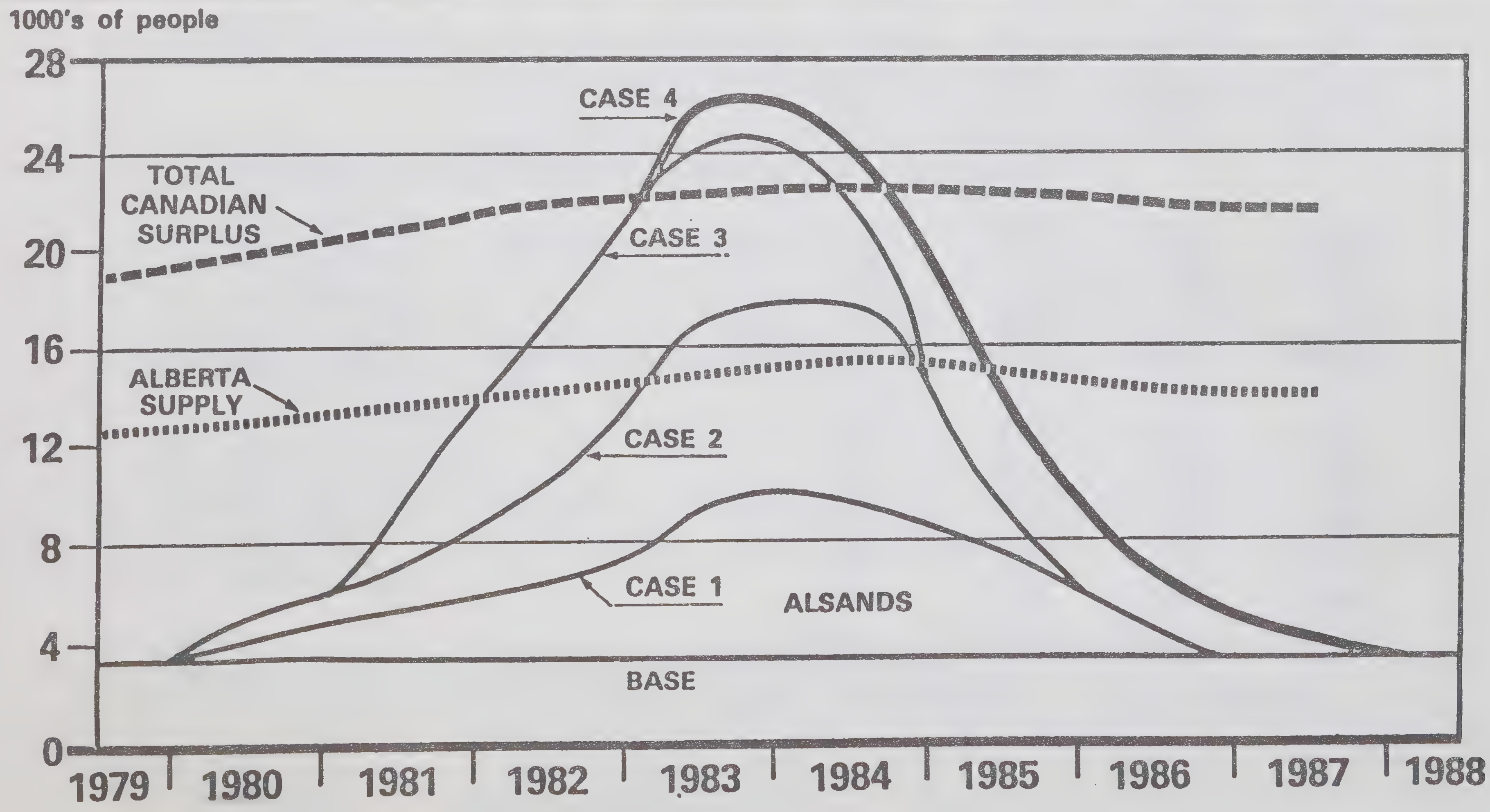

Table III-3

TOTAL DEMAND FOR MANUAL TRADES: TOTAL ALL MEGA PROJECTS

	Blrmkr	Crpntr	CemFin	Electr	Insul	Irnwrk	Labour	Millwr	OpEng	Pipe	PipWld	ShMetl	Teamst	Total
79/01														
79/02		17		10			28		6	7	7			75
79/03	4	82	1	15		114	78	5	56	30	11			396
79/04	4	59	16	37		174	81	3	81	47	19			521
80/01	15	80	13	63		147	88	15	84	102	28			635
80/02	20	108	13	92	35	93	389	20	332	316	34		84	1,536
80/03	12	61	14	120	60	27	538	13	490	592	25		162	2,114
80/04	10	51	6	105	60	21	293	11	284	308	30	12	72	1,263
81/01	3	58	4	78	5	13	222	10	335	134	23	8	55	948
81/02		83	3	110	3	26	613	7	831	507	22	10	220	2,435
81/03	13	119	4	123	5	52	1332	2	1492	929	25	10	424	4,530
81/04	32	188	21	148	3	80	1113	6	1051	340	35	10	371	3,398
82/01	53	224	23	203		107	1933	15	1782	1109	50	22	741	6,262
82/02	115	379	30	356	15	133	1331	18	1721	561	75	16	469	5,219
82/03	195	509	41	512	15	219	2529	22	2587	966	115	16	779	8,505
82/04	310	617	55	674	5	381	2025	33	2285	975	170	26	709	8,265
83/01	456	689	79	896	29	548	2978	41	2977	1704	240	30	1098	11,765
83/02	605	811	89	1123	101	706	2296	96	2873	2064	310	72	839	11,985
83/03	807	943	118	1353	169	789	3033	134	3475	2612	345	127	1175	15,080
83/04	757	977	117	1341	272	740	2394	139	2573	2376	360	173	964	13,183
84/01	762	932	128	1354	392	750	2815	160	3004	3219	365	204	1183	15,268
84/02	751	931	121	1601	548	776	2790	192	2938	3759	370	214	1118	16,109
84/03	683	1014	119	1716	705	713	2694	224	2672	4037	370	219	1101	16,267
84/04	686	822	124	1673	998	729	1784	203	1919	3300	370	217	709	13,534
85/01	721	744	126	1647	1228	589	1431	210	1330	2655	365	202	512	11,760
85/02	707	629	101	1408	1344	475	1228	196	1120	2429	300	201	404	10,542
85/03	518	499	75	920	1305	426	890	146	849	2050	180	222	313	8,393
85/04	379	373	52	659	955	347	627	84	645	1809	75	168	266	6,439
86/01	253	281	47	527	459	234	460	89	514	1624	20	145	226	4,879
86/02	120	201	20	460	117	131	291	73	348	1600	5	132	163	3,661
86/03	97	138	17	375	299	60	197	54	237	1151		65	108	2,798
86/04	85	89	17	249	353	26	138	37	150	572		28	65	1,809
87/01	49	62	14	142	314	17	100	33	106	288		29	46	1,200
87/02	20	31	9	57	193	9	53	21	55	106		19	25	598
87/03	10	13	4	29	75	4	21	9	21	33		8	9	236

Notes:- Manual Construction trades for the Suncor, Alsands, Cold Lake and Alaska Highway Pipeline (all Canadian portions).

Cont'd.

Table III-3 Continued

Notes:- Based on data provided by the companies and on the announced schedules.

- These are preliminary data and will only be finalized as detailed construction schedules are finalized.

- Trades are as follows: boilermaker; carpenter; cement finisher; electrician; insulator; ironworker; labourer; millwright; operating engineer; pipefitter; pipefitter-welder; sheet metal worker; teamster; total.

- Last update 02/06/80.

Source: Employment and Immigration Canada, Economic Services Branch, Alberta/NWT Region, Major Project Update, Edmonton, June, 1980, Appendix II, Table 16.

engineers is expected to remain strong at least until 1984, with shortages occurring in 1982 and 1983.[1] After 1984, some surpluses are projected. These projections are based on assumptions of moderate growth in both the supply of and demand for engineers. However, the TSC projections are on a national basis and for all industries. More severe shortages can occur in some parts of the country and in particular industries. Construction is expected to be one of these industries and Alberta and Saskatchewan are two of the areas where shortages are present now and are likely to continue and may be accentuated if there is more "bunching" of the mega projects due to delays in the startings. The CEMC study of major energy projects forecasts demand for engineers ranging from 10.7 thousand to 15.4 thousand between 1981 and 1983, compared with current employment of 9,000 Canadians on these projects. Later in the 1980s and in the early 1990s demand is expected to increase to over 30,000 in some years.

In its October 1980 "Submission to the Government of Canada's Task Force on Employment Opportunities for the 80s", The Association of Professional Engineers, Geologists and Geophysicists of Alberta declared:

> "...if the various industrial developments that are now being planned or proposed actually proceed, there will be a very serious shortage of Engineers and other technical personnel in Alberta for the next several years." (p. 7; emphasis added)[2]

Similar declarations could come from Newfoundland, Nova Scotia, Manitoba, and British Columbia if large energy-related projects are undertaken parallel to those expected in Alberta and Saskatchewan.

The current demand in Canada is very high for qualified engineers. The national unemployment rate for engineers in 1979 was 0.4 per cent, which is much less than is normal for frictional unemployment.[3] The shortages are

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1/ As the MOSST study does not forecast supply, no projection of imbalances is available from it.

2/ See also the report prepared for CEIC by L. Blackman for information on shortages of engineers and engineering technologists in Alberta.

3/ Canadian Council of Professional Engineers, unpublished data.

commonly believed to be much more acute for experienced engineers and project managers than for recent graduates. A similarly high level of demand exists elsewhere in the world, but especially in the United States. The Deutsch, Shea and Evans Index of Engineering and Scientific Demand, which measures the demand in high technology employment and which is a leading indicator of the direction of economic change, hit its highest level in the 18-year history of the index in October, 1979.[1] With demand so high in the United States and large energy, industrial and military projects expected there in this decade, there may be very limited possibilities of importing engineers to meet Canadian demand or of having international engineering firms do work on Canadian projects at their U.S. headquarters; in fact, there may be some drain from Canada to the United States.

With the demand for engineers being experienced in Alberta, there is some concern about engineers moving to Alberta from other parts of the country which have slower growth rates. The Winnipeg Construction Association, for instance, feared the consequences of this loss on the ability of the construction industry in Manitoba to meet even the current low level of demand.

In assessing the above demand/supply situation for engineers, it is important to add that Canadian engineers are becoming increasingly involved in employment on projects being constructed outside Canada, as consultants to foreign governments or companies and as designers of projects in foreign countries for companies located in Canada. Currently available demand/supply forecasts do not take full account of these factors and, therefore, tend to underestimate future demand.

Though precise data are not available, there is widespread concern that shortages are developing for engineering technologists and technicians. As will be enlarged upon in Chapter IV, this could impose a significant restraint on measures to deal with a shortage of engineers.

1/ P. J. Sheridan, "Employment Opportunities For the New Engineer", Engineering Education, January 1980, pp. 227-8.

Summary

Shortages are expected for a number of the skilled trades, for engineers, and potentially for engineering technologists and technicians. The shortages will probably be most serious around the middle and end of this decade, though the precise timing will differ by occupation and geographical area according to the number and scheduling of major projects.

Chapter IV

MATCHING SUPPLY AND DEMAND

With rather clear evidence of current and developing imbalances between the supply of and demand for skilled construction personnel, the question arises as to how best to match the two in order that demands may be met as far as possible.

To achieve matching it is necessary, of course, to know the location and type of demand and the location and type, by occupation, of supply. The evidence seems clear enough that imbalances exist or are developing in some regions, but the situation for Canada, as a whole, is much less well known. Hence, before examining specific matching strategies, consideration needs to be given to the development of better information.

As noted earlier in this report, detailed information on the supply of and demand for skilled construction personnel was available by occupation only in Nova Scotia, Saskatchewan and Alberta. Projections on a macro basis have been prepared by Informetrica, the Canadian Construction Association, COFOR and the Labour Market Development Task Force, but on demand only and not disaggregated by occupation. Moreover, the considerable variance among them raises questions as to how they could be used by manpower planners. Substantial disagreement was noted as well between the MOSST, TSC and CCPE estimates of demand for engineers. The information on labour demand by detailed occupation available at the local and provincial levels is based on different data elements, definitions and processing and analytical methodologies, thus limiting its usefulness for comparative purposes and for aggregation into a national or even a regional perspective on demand.

The situation on the supply side is summed up by W. L. Motuz, an economic consultant to CEIC [1/]:

1/ Motuz, W. L., An Assessment of Data Sources Regarding Supply and Mobility Among Construction and Manufacturing Trades, October 1, 1980, p. 15.

> ". . . the paucity of useful data is a reflection not so much of the absence of data but of the low priorities attached to presenting it in a useful, comparable form."

During discussions with various parties (federal and provincial governments, private and public buyers of construction, construction contractors, major project planners, professional engineering associations, labour unions and educators) interested in construction manpower, they emphasized how important good data were to their decision-making and planning. They expressed widespread support for better and more readily available data on the demand for and supply of skilled construction personnel, not only for Canada but also on a world-wide basis. Support was strong both in those areas expecting major construction investment during the 1980s (Alberta and Nova Scotia) and in areas of low growth (Manitoba and New Brunswick)[1], where the emphasis is on finding employment for the unemployed construction workers and on replenishing with sufficient numbers of apprentices the stock of workers who have retired or migrated.

Concomitant with the development of an information system, there was also support for initiatives that would illustrate the benefits and possible uses of such a system and train those interested, especially the small/medium-sized contractors, how to use the system to their maximum benefit. A construction labour information system, which will be described more fully presently, is in use in the United States and officials there report a very keen interest from potential users.

The number of major projects being developed in Canada, the United States and elsewhere in the world places a potential drain on the Canadian supply. There is already a world-wide market for qualified professional engineers and project managers and a developing multi-national market for qualified and experienced technologists and the possibility, depending on the acuteness of the demand, of similar patterns occurring for some highly skilled tradesmen and foremen.

1/ See the submission by the New Brunswick Construction Association to the House of Commons Task Force on Employment Opportunities For the 80s.

The scarcity of data and the inconsistencies in what were available, together with this widespread interest in obtaining better information, lead to a fairly early conclusion that a new information system was needed in Canada to provide an outlook for the forward supply of and demand for skilled construction personnel. All the major parties involved in construction would benefit. Buyers would be able to take account of labour market conditions locally, regionally or nationally when planning projects; contractors could plan their manpower requirements including taking on apprentices for training; unions would have better information on the national supply/demand picture for tradesmen and on the need for additional apprentices; and governments would be able to pattern training, mobility and immigration policies and programs more closely to actual needs. Governments should benefit as well from improved utilization of construction personnel and a resultant reduction in unemployment on one hand and reduced inflationary pressures on the other hand.

As a prelude to proposing an information system, a review was made of schemes that are in operation in Nova Scotia, Ontario, Saskatchewan, Alberta and in the United States. They are outlined in some detail in Appendix C. The system proposed for Canada as a whole draws where appropriate on those in actual operation.

Some of the major lessons learned from this review include:

- The Information System should be independent and have a sound institutional structure and organization.
- It should include the participation of all major interested parties; all parties should be equal and should share in the cost and effort of providing data as well as in the benefits of using the information produced.
- The system should have sufficient and stable funding for enough time to develop the system and to operate it during its early years.
- The system should have as its prime functions the collection, processing and dissemination of accurate, up-to-date and pertinent information on the supply of and demand for construction labour. The information should be produced in an easily understood form.

The system should use existing raw data as much as possible and data and forecasting factors that are easily understood and commonly accepted by the industry, preferably using project-based data as much as possible.

Chapter IV

Part I

Personnel Information System

The main purpose of the Information System would be, of course, to provide forecasts of supply of and demand for skilled construction workers by occupation, type of construction, and geographical location. As well as a detailed outlook for Canada, a more general view of international supply and demand would be included. Analysis of the data would identify likely imbalances and might suggest solutions. The System would issue standard publications and could also conduct special simulations and studies for clients.

Ultimately the System might serve a useful purpose in functions such as collective bargaining or productivity analysis and in the general areas of policy and operational decisions. Its initial purpose would be, however, to identify imbalances in the supply of and demand for skilled manpower. This would include project simulation and impact analysis of major projects on the labour market. The importance is stressed of keeping the System simple and easily understood in both concept and operation so that the results can be used readily and effectively and both suppliers of information and users of the results will be encouraged to continue their participation.

The Demand Side

This component of the Information System would be modeled closely on the Construction Labour Demand System (CLDS) currently in operation in the United States.[1] The CLDS produces short to long-term forecasts of the demand for construction labour by trade and by detailed geographical location for each of the major types of construction.

1/ As indicated earlier, the Construction Labour Demand System is described in greater depth in Appendix C.

For non-energy related construction the CLDS relies on the F. W. Dodge data on construction starts for short-term forecasts and on econometric model information in the National-Regional Impact Evaluation System (NRIES) for the longer term. For energy projects, information is gathered annually on each project planned or started.

The main strengths of the U. S. system are:

a) It is project-based for short-term forecasts. Both the start information and the forecasts are based on actual projects and, as well, the investment-to-labour co-efficients are derived from actual projects. This information is well accepted in and understandable to the users of the system. The data are easily verified for accuracy and timing. This approach reflects latest activity in the marketplace, including changes in technology and productivity.

b) It uses existing data as much as possible and minimizes the cost and efforts required of the staff of the CLDS in raw data collection. The emphasis within that organization is on processing and analysis.

c) It provides remarkable flexibility in producing combinations of data needed for the most generalized or most detailed kinds of analyses.

The main weaknesses of the U. S. system as presently constituted are:

a) It does not include own-account construction or repair/maintenance

b) It requires considerable effort and expense to regularly update the investment-to-labour co-efficients.

c) It does not undertake to gather information on supply.

For this system to be adopted in Canada, it would be necessary to build on its strengths and to overcome its weaknesses as much as possible.

The main considerations are assurance that there are satisfactory data based on construction starts and planned major projects, investment-to-

labour conversion co-efficients and regionalized econometric models in Canada equivalent to the U. S. National-Regional Impact Evaluation System.

For the non-energy sector, the Canadata Construction Starts data prepared by Southam Communications Limited should be used in the same role as is the F. W. Dodge start information in the CLDS. However, the Canadata data will have to be modified to include completion dates, and improvement in the coverage for engineering construction is needed. For the energy sector, and possibly for major non-energy projects, each project should be surveyed as in the CLDS; the current work on major projects being done by the Department of Industry Trade and Commerce should be useful in this regard.

Although Canada has no exact equivalent to NRIES, it does have some econometric models singly or in combination that could be used to perform the required tasks. These could include, for instance, the Economic Council of Canada's Candide, Informetrica's Construction Investment Forecasting Model, and the provincial models.

Information on investment-to-labour co-efficients would probably have to be developed especially for the Information System. Initially the co-efficients used for the northern U. S. states in the CLDS might be used if they look comparable. In the mid-1970s, an Ontario study developed co-efficients that might be used experimentally.[1] For regulatory approval of major energy projects, it is necessary to calculate personnel requirements directly at the planning stage. This by-passes the usual step of relating labour to investment that may fluctuate substantially in times of rapid inflation but without affecting personnel requirements.

Information on current job vacancies is available through a variety of institutional sources at present. These sources include: for highly-skilled tradesmen, the union hiring hall network, major project hiring offices, and the CEIC National Job Bank (NJB); and for engineers and engineering technologists, the private personnel placement agencies, engineering and

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1/ Supply and Demand for Construction Labour in Ontario, prepared by Peter Barnard Associates for The Construction Industry Review Panel and the Ontario Ministry of Labour, Toronto, November 1974. See Appendix C.

construction firms, major project hiring offices and the CEIC National Job Bank. The latter is a computerized job vacancy inventory operated by CEIC on a Canada-wide basis.

There may be some merit in exploring whether improved co-ordination among these sources would produce faster and more satisfactory match-ups between employers and potential employees.

Information about the immediate demand for skilled personnel is available through the NJB. A computer print-out of job vacancies that has not been filled from local supply is distributed to all Canada Employment Centres (CECs). Through the use of telephone hook-ups between the NJB computers in national CEIC headquarters and the CECs representing the employers and the job applicants, the matching of supply and demand is accomplished.

The National Job Bank, a fairly recent creation, has been used only to a limited extent in the construction industry. Because of its speed, ease of operation, and geographical comprehensiveness, it would seem advantageous for this industry to make better use of it, especially in the case of major projects which will require labour from across Canada.

The Supply Side

The Information System will have to combine supply information of different types and from various sources into a comprehensive supply component. Much more work will be required than is the case for the demand side since, as mentioned earlier, the CLDS in the U. S. does not cover supply and hence will not provide a base on which to build supply information for Canada.

A detailed description of the supply component is not specified here as it will, of necessity, have to grow hand-in-hand with the development of the data base. For the latter one should rely on data supplied by each province using a common set of data elements but, as outlined below, possibly using different approaches in the collection of the raw data. In some provinces supply data are fairly well developed, in others a procedure

will have to be set up.[1]

Because of the long lead-time required in their training and their relatively limited occupational mobility in the construction industry per se, the initial and probably continuing emphasis should be on the high and medium-skilled trades (i.e., trades requiring at least three years of training). Moreover, concentration should initially be on those trades identified as likely to be in short supply in this decade and especially those covered under the Red Seal Program.

Different approaches are needed for the collection of data on (a) the stock of skilled personnel in the industry and (b) the flow of graduates from training/education into the industry from immigration, migration, et cetera. There are various ways of obtaining the information on current stock of journeymen. In Nova Scotia, the data has been collected by surveys of unions and contractors; in Quebec, this information could be obtained from the office that registers all construction workers in the province; in other provinces, the above methods or variations to them may be used. The Canadian Engineering Manpower Inventory should be the major source of data on the stock and characteristics of professional engineers. This inventory could also serve as a model as to the data elements needed. If a similar inventory for engineering technologists and technicians were created, it would be invaluable for determining the stock of these skilled personnel.

Information should be collected on the occupation, age, experience, technical qualifications, and type of work acceptable to each worker (i.e., industrial versus non-industrial projects). This type of information will show rates of attrition, potential for mobility, and the types of construction projects that can be staffed with the personnel available.

A standardized approach should be possible for collecting information on enrollment in apprenticeship programs and engineering and engineering technologist/technician programs, including drop-out rates, and actual and expected graduation rates.

1/ The recently developed Manpower Requirements Forecasting System in Ontario appears to offer good potential.

Data on immigration, mobility and unemployment can be obtained through CEIC. Data on population and labour force participation is available from Statistics Canada.

The information and the methods needed to develop the supply side are now available or can be developed within the short/medium term. The main problem will be to organize the collection of data and to develop standards as to data elements and methodologies in a manner acceptable to all parties concerned, particularly those in the governmental sector.

International Demand and Supply

In conjunction with the development of better information on the construction labour market in Canada, there should also be an improved awareness of the labour situation abroad. On the demand side, major projects, particularly in the energy field that will require the services of engineers and technologists and those in the highly-skilled trades, are being constructed throughout the world. Canadian projects competing for skilled personnel, both foreign nationals and Canadians, in the international marketplace should be aware of the degree of demand and the sources of potential competition.

On the supply side, the availability of skilled foreign nationals to work on Canadian projects seems to be much less than in previous years. It will be necessary to monitor regularly the traditional sources, especially Western Europe, to determine how much reliance Canada can place on immigration, temporary or permanent, to meet its labour needs.

It seems advisable that information be assembled semi-annually by CEIC on (a) major international projects and the labour demand created by them, and (b) the actual and potential supply of skilled construction personnel likely to be available for Canadian projects, should the need arise. Information on demand is available from numerous sources, including international organizations, national governments, industry publications and buyers of construction.

Information on supply should be collected by using the services of Canadian diplomatic personnel abroad (e.g., labour attachés), supplemented by information supplied by national governments. The countries surveyed should be limited to those that have been major suppliers in recent years and that have training standards comparable to those in Canada.

Using this information, the Construction Information System should prepare reports that would make comparisons between the national and international supply of and demand for construction labour.

Participation and Organizational Structure

Participation in the Information System should include the major parties involved in the construction industry. Mainly these would be:

- federal government - CEIC, IT&C;
- provincial governments - departments of labour or manpower and post-secondary and vocational education;
- construction firms - possibly as represented by the Canadian Construction Association;
- buyers of construction - representation from owner-clients councils and other business groups;
- labour; and
- educational institutions or their associations.

All of the above are potential users of the Information System, as well as possible suppliers of data to it. All could use the reports prepared by the Information System in their manpower-planning and decision-making processes. The quid pro quo principle of "everybody contributes, everybody benefits", upon which the Nova Scotia Construction Trades Inventory was built, seems to have worked well there and should form the basis for the collaboration of the parties involved in the national Information System.

The Information System should be established as a not-for-profit corporation. This type of body, in practice and in theory would

be independent and would not be under the undue influence of any one of the participants. It should have a board of directors drawn from the major parties involved in construction. In general, the board would decide the type of work and projects to be undertaken, would ensure the quality and timeliness of the results, and would advise all interested parties about possible courses of action to overcome imbalances or problems in the construction labour market. Good communication would be maintained continually with policy makers.

More specifically, the board of directors would be responsible for:

a) establishing priorities for the work of the corporation and determining the types of publication to be produced;

b) ensuring that the data be collected, processed and disseminated in as accurate and rapid a manner as possible;

c) identifying manpower problems in the industry as revealed by the analysis of the data and proposing ways that these problems might be resolved; and

d) encouraging and assisting the users of the information to make the most effective use of it in their manpower planning.

The organization and staffing of the Information System could be along the following lines, under an Executive Director:

Data Analysis Branch
- Director
- + 3 professional staff

Computer Services Branch
- Director
- + 3 professional staff

Data Collection Branch
- Director
- + 3 professional staff

Special Projects
- Director
- + 3 professional staff

A total of 17 professional staff is indicated, plus the option of hiring other staff and/or outside consultants as the need might arise. This type of internal organization would allow the system to keep the data and the methodologies current, process the data, do research, prepare publications and react to the needs of clients making special requests.

Cost of the Information System

There are two major elements to include in the cost estimate of the Information System: first, the development of the System; second, the operation of it. The development cost includes the design of the System, the collection and processing of data and the establishment of an effective dissemination network. The cost shown for the demand component of the System assumes that the methodology and many of the processing techniques could be adapted from the CLDS to the Canadian setting with minimal effort and cost. The supply component would have to be developed without this advantage. A data collection system needs to be developed and a methodology for matching the stock and flow data would have to be created. At some point an economic/social preference model could be developed to identify which projects are more likely to proceed in cases of severe labour shortages. It is estimated that it would cost approximately $600,000 and take one to one and a half years to develop the demand side; approximately $800,000 and at least two years for the supply side; and about $200,000 to develop supply/demand matching methodologies. Including $400,000 for contingency purposes would bring the total developmental costs to around two million dollars.

The operating costs would include data collection/purchase, computer processing, publication costs, physical facilities, travel, and wages/salaries/fringe benefits. It is estimated that this would cost approximately $2,000,000 per year in terms of 1981 dollars. However, some of these costs could be recovered from the sale of publications, and the charging of clients for the direct and indirect costs associated with the processing of special requests initiated by clients for their own

private use (e.g., project simulations or impact analyses). At this time it is uncertain what financial returns these "sales" would generate.

The costs associated with the Information System must be viewed in the context of total annual construction expenditures in Canada of over $42 billion in 1979 - or even in the context of a $1 billion mega project. If better information on the supply of and demand for skilled construction personnel would reduce delays, result in the better use of training funds and, in general, contribute to the more efficient use of manpower, the cost of providing the information would be far outweighed by the potential benefits. Moreover, as observed earlier, considerable work is already being done - and costs incurred - in some provinces and by project developers but with less effect than could be expected from the proposed national system.

Financing the Information System

The establishment of an effective Information System requires a long-term commitment from its sponsors and sufficient levels of funding to develop the System properly and then to operate it. The development phase should be financed through a lump-sum grant large enough to cover the creation of a fully staffed and operational system. So that no one participating group could claim more influence than another, financial contributions should be forthcoming from all the major parties involved. The CEIC should be prepared to provide support for the difference between the total development cost and the contributions from the major parties. Once the System becomes operational it should be based on (a) multi-party sponsorship through direct grants and (b) user charges for special projects or services and for publications. The System should aim at becoming as self-supporting as possible through the generation of its own product-based revenue.

The First Step

While it is considered important that no participating group has a dominant role in the Information System, initiative and leadership are required in order to get it organized and underway. Because of its mandate and national scope, the CEIC would appear to be best suited for this role and it is recommended that the Commission call together a working group comprising buyers of construction, contractors, unions, educators, and provincial and federal government representatives to lay the groundwork for the Information System. This could likely be done most effectively after the report of the Labour Market Development Task Force has been circulated and considered.

Chapter IV
Part II

Adjusting Supply and Demand

Returning to the subject of matching supply and demand, two approaches can be taken to achieve a balance. One would be to adjust supply, the other to adjust demand - or a combination of the two could be employed. Since demand usually arises out of legitimate economic and social objectives, such as in the current situation, to reach energy self-sufficiency, it seems preferable to first pursue all possible opportunities to not interfere with demand, but rather to adjust supply in order to reach a matching of the two.

A. Adjusting Supply

Supply can be increased by mobility, the use of semi-skilled specialists, immigration, overtime, training and education, productivity and factor substitution, and technological change. In general, the supply of journeymen should be kept at levels consistent with the longer-term trend in demand. Peaks should be met through mobility, the use of semi-skilled specialists, immigration and overtime, the same approaches that offer the best opportunities for increasing supply sufficiently quickly to alleviate short-term shortages.

Short-term Strategies

Mobility

As outlined in Chapter II, overall mobility includes a number of different types; viz., geographic, inter-occupational, inter-sectoral, inter-functional and inter-industry mobility. To date at least, and likely in the future, geographic mobility has been much more significant than any of the other forms. Indeed, the recent

Task Force on Construction Mobility[1] looked only at the geographic shift of workers from one location in Canada to another. Particularly when unemployment is running at unacceptably high levels in some areas and to meet short-term needs, geographic mobility offers a potentially significant solution to shortages in other locations.

In terms of construction workers, this is illustrated rather effectively by the material prepared by the Alsands Project Group and reproduced in this report as Tables III-2(a) and (b) and Chart III-2.

As will be noted, if the total Canadian surplus of construction labour could be moved to Alberta, and assuming the unlikely good fortune of an appropriate mix of skills, the labour shortfall anticipated in Case 2, and a large part of that in Case 3, would be eliminated completely. The chart should be modified to take account of the recent postponements of the Alsands and Cold Lake projects. If one or both are cancelled completely, as is reported to be a possibility, the chart would have to be entirely redrawn, but in the meantime it does illustrate the potential of mobility to solve labour shortages.

Substantial interprovincial migration of the Canadian population does take place - from 1971-76 it averaged over 180,000 persons per year.[2] This would include substantial numbers of workers and reflects to some extent the Canada Manpower Mobility Program that provides various grants for seeking fiscal employment and/or travelling to it. In the first nine months of 1980-81, 861 grants were given to the construction industry (Tables II-7a-c).

1/ E. MacNeil and M. Stein, Canada Employment and Immigration Commission, A Report by the Sector Task Force on Mobility in the Construction Industry, Ottawa, 1980.

2/ Canada Employment and Immigration Commission, Legislative/ Regulative Barriers to Interprovincial Labour Mobility, Ottawa, October 29, 1979.

Notwithstanding the efforts that are made to increase mobility and the substantial migration that actually takes place, some very important impediments exist to the temporary movement of construction workers from one part of Canada to another. They include:

a) Room, Board and Travel - The Mobility Task Force found these to be the most important factors that determine whether a worker will leave home to work elsewhere. Employers were reluctant to pay room and board, however, because in many instances they were forced to pay it for local workers as well.

b) The CEIC Mobility Program - It does finance travel for temporary work, but it has not been used much by construction workers because it does not offset the cost of living away from home; it precludes the payment of travel allowances to construction workers; the minimum six weeks employment requirement is not always appropriate for construction, and the program is not well publicized or well known. Apart from giving attention to these obstacles, it has been suggested that the Program would be more effective if the grants were applicable to both employer and employee and were scaled to reflect factors such as distance of move, type of locality, type of industry, job duration, commitment to training, et cetera.[1]

c) Taxation - When room, board and travel is paid by the employer, they are generally subject to tax in the hands of the construction worker. When they are not paid by the employer, they are not deductible from the worker's taxable income, in either case substantially reducing a worker's incentive to work away from home. The Mobility

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1/ Internal CEIC memo prepared by Jean E. Gravel, Senior Industrial Consultant.

Task Force calculated that an unemployed Halifax worker would be ahead only $7.00 by taking a job in Edmonton for eight weeks if he had to pay his own travel and living expenses. To the employee, wages and net financial gain are, of course, the main incentives for short-term mobility.

Some 40 recommendations are presented in the report of the Task Force on Mobility.

Other barriers to geographic mobility that were cited include non-standardized licensing, certification and apprenticeship training among the provinces, provincial legislation that inhibits worker mobility, lack of portability of health, welfare and pension plans, lack of manpower planning by employers and lack of widespread exchange of information among union hiring halls, and an overall lack of information on the supply of and demand for labour.

The lack of standardization of apprenticeship training and accreditation in Canada is a serious deterrent to the mobility of apprentices to staff job vacancies or to continue the on-the-job portion of the apprentice's training. (See later section on Training and Education.) Unless an apprentice's prior training is recognized and credits are given for it in the province to which the apprentice moves, there is a strong disincentive to migrate either temporarily or permanently.

Table IV-1 indicates that among Nova Scotia tradesmen some tend to be more mobile than others. Similar findings were recorded among construction workers in Ontario in the mid 1970s.[1]

1/ Peter Barnard Associates (Report for The Construction Industry Review Panel) Reducing Cyclical Unemployment in the Construction Industry; Phase 3 Report: Pilot Project: Approach and Methodology, Toronto, 1974, Table 6.

Table IV-1

Relative Mobility of Workers
in Construction Trades
Nova Scotia

Highly Mobile	Above Average	Average	Below Average
Millwrights	Plumbers	Bricklayers	Labourers
Elevator Constructors	Sheet Metal Workers	Insulators	Plasterers
Ironworkers	Electricians	Carpenters	
Pipefitters			
Boilermakers			

Source: Nova Scotia, Department of Labour et al., The Construction Trades Inventory, Halifax, 1979, p. 86.

The following quotation regarding the mobility of engineers points up some of the barriers they see:

> "People who would have moved willingly a few years ago, now refuse for several reasons: 1) high real estate prices; 2) an increase in the number of working wives; 3) more family participation in decision making; 4) changes in the work ethic; 5) pay incentives reduced through high taxes; 6) lack of probability of pensions." [1]

Little information is available on types of mobility other than geographic. There does seem to be some possibilities of obtaining workers from other industries, but it is uncertain how many will be in the highly skilled occupations. It seems fair to assume that the other types have less

1/ Humble, op. cit., p. 10.

potential than geographic mobility for making significant contributions to the alleviation of manpower shortages. Some work on the other types to supplement the work of the Task Force on Mobility would make a useful contribution to a better understanding of the whole subject of worker mobility.

<u>Immigration</u>

It was noted in Chapter II in connection with the supply of skilled construction personnel that immigration, either permanent or temporary via employment authorization, had been a traditional solution to shortages in Canada. For a couple of main reasons permanent immigration is expected to be much less of a factor in the 1980s. First, with high unemployment rates in Canada the government will try to limit immigrants to solving serious shortage situations and will try to issue only temporary employment authorization. Second, better employment opportunities and higher incomes in other countries have reduced the attractiveness of immigration to Canada.

If serious shortages develop, however, in spite of other measures taken to alleviate them, immigration can still be a significant source of skilled personnel. As noted in Table II-8, the number of immigrants in the first six months of 1980 who were planning to take jobs in the construction trades was roughly equal to that of the full year 1979.

Qualified engineers appear to be in as short supply in other countries as in Canada. Large international contractors, however, may be able to use their well developed personnel networks to obtain engineers from abroad. Smaller firms may have a more difficult job, but may have more flexibility in the type of job offer.

Overtime

This is likely the first and most frequently used means of overcoming the effects of labour shortage. It can be used either in the short term or longer term, though it would become somewhat expensive if used excessively. On the other hand if the cost of labour is only a modest proportion of the total, or if there is a premium for completing a job on time, the cost of overtime may be readily justifiable. A hidden cost could arise if overtime was used to the extent that it eventually resulted in lowering a worker's productivity.

The additional earnings can be a powerful incentive to encourage scarce workers to migrate from other regions and, as noted earlier, can be an important incentive for mobility.

Short/Long-term Strategies

Training and Education - Skilled Workers

The appropriateness of training as a solution to shortfalls in supply depends on the lead times available and the types of personnel needed. At present, four to five years of advance notice is usually required to produce qualified journeymen in the highly skilled trades (e.g., pipefitter, welder, electrician). On the other hand, other personnel can be trained in several months (equipment operators) or a few weeks (labourers and helpers). The more highly skilled trades are trained through apprenticeship, while the less highly skilled receive their training in institutions such as community colleges, or on the job. Thus, increases in training activity could be highly successful to meet shortages next year for the low to middle skill level trades, but of less value if highly skilled trades are needed.[1] There does not seem to be very

1/ Training programs are in regular use, however, to upgrade and broaden the skills of journeymen. Syncrude, for example, established a special course in blueprint reading for skilled tradesmen.

much concern in the construction industry about overcoming shortages in the trades with lower levels of skill.

The supply of the highly skilled trades is a different story. Without a clear indication of the long-term supply/demand picture, there is very little incentive to start apprentices, though there is a long waiting list of applicants. Employers are reluctant to bear the cost of an apprentice redundant to current levels of demand. Unions do not want to have their journeymen threatened by unemployment or unwanted relocation in order to keep apprentices employed. Governments do not want to incur the expenses of providing apprentices with the institutional aspects of their training only to find them as unemployed journeymen. Without means whereby apprenticeship can be buffered from the effects of the cyclicality of the construction industry, it is unlikely that the problems of periodic shortages of highly skilled journeymen can be eliminated.

As well as serving as a deterrent to mobility, the absence of standardization of apprenticeship training across Canada and of accreditation for previous training undertaken in their home province has seriously hindered the completion of apprenticeships and impeded the entry of new students into apprentice programs in areas of low levels of current demand. These problems arise because the apprenticeship system of education depends so heavily on training on-the-job. Unless the apprentice can obtain work, he cannot continue his education or support himself financially.

Some improvements in maintaining the continuity of the apprentice's on-the-job training have been achieved by indenturing the apprentice to a committee rather than a single firm, thus providing the opportunity for the apprentice to move from firm to firm in a more orderly fashion as market conditions dictate. If, however, there is no work available

in the apprentice's trade in his home province, there are three options currently open to him:

a) migrating to another province with the possible loss of credits and a resultant lower pay scale;

b) leaving his apprenticeship temporarily until demand in his trade in his home province improves and supporting himself by employment in another occupation, unemployment insurance or welfare;

c) leaving his apprenticeship permanently and entering another occupation.

None of these options is constructive in the educational and career development of the apprentice.

It would seem highly beneficial for both the apprentice and the employer seeking skilled tradesmen for these unemployed apprentices to be able to continue their on-the-job training in areas where jobs are available.

If apprentices were able to move freely between provinces for their training, both institutional and on-the-job, the completion rates would be expected to increase and there would be greater incentive to admit more students to apprenticeship programs seeing a current and future demand for them somewhere in Canada.

The existence of national standards and accreditation procedures would also increase effectiveness in the organization and utilization of institutional training for apprentices. Apprentices would no longer have to both work and study in the same province. Provinces with low current requirements for apprentices and with underutilized institutional facilities (e.g., the Maritimes) could train apprentices from other provinces that are faced with overutilized facilities (e.g., Alberta). Such a system could reduce the need to construct new educational institutions just to meet an abrupt increase in demand for apprenticeship training. Of course,

suitable financial arrangements would have to be made to compensate for the use of these facilities.

Another benefit from standardization and accreditation would be to increase the possibility of conducting longer-term manpower planning. Provinces with slow current demand but strong future demand for journeymen could train to meet expected shortfalls. These provinces could provide the apprentices with the institutional training and let them obtain the on-the-job training wherever work was available.

All parties interested in apprenticeship training should work towards standardization and accreditation of apprenticeship training. Initial emphasis should be on trades having a Red Seal program for journeymen, with special efforts concentrated on those trades identified in Chapter III, that are expected to experience shortfalls in the 1980s.

Realizing that this could be a lengthy process, especially if it meant modification of curricula, which would affect only new entrants into apprenticeship, immediate steps should be taken to develop equivalency profiles for the current stock of apprentices. These profiles would indicate for each trade how the apprenticeship programs in each province compared on a course-by-course and year-by-year basis. With this information, apprenticeship boards could determine quickly how training compares between provinces and possibly after the administration of qualifying tests, how much credit would be given to apprentices who migrate.

To facilitate mobility of apprentices for the purposes of on-the-job and institutional training, greater use should be made of the trainee and temporary employment sections of the Canada Manpower Mobility Program. Some changes in the terms of reference of this program may be needed to serve these ends. As shown in Table II-7a, very little use is made of the

student grants by the construction industry. Greater co-ordination will also be needed between the CMMP and CMITP, and possibly CMTP.

Accurate and up-to-date information on job vacancies across Canada is essential if apprentices are going to be able to use geographical mobility as a strategy for overcoming the effects of cyclical instability on their educational development. The union hiring hall network and the CEIC National Job Bank must play key roles in this regard.

The whole issue of training could be handled more effectively, of course, if there were highly reliable medium and long-term forecasts available that would not only pin-point shortages in the highly skilled trades but trigger appropriate entries into training programs to meet the demand. Alberta has already started doing this to meet the demands anticipated in the mid-1980s by the energy-related mega projects.

Unfortunately, even allowing for geographic mobility within the same occupation, and even overtime, there probably will not be enough time to meet the large demand for skilled journeymen in the mid-1980s for the mega projects using the traditional apprenticeship approach. Other solutions need to be considered. These include:

a) developing alternative approaches to traditional apprenticeship training that would shorten the training time;
b) training semi-skilled specialists for employment on projects facing labour shortfalls; and
c) using skilled workers from outside Canada on a temporary or permanent basis (as discussed earlier in the section on immigration).

Given the high levels of unemployment in Canada and the very high demand for entry into apprenticeship programs, it seems worthwhile to concentrate on approaches a) and b) in preference to c). Of course, if the former approaches do not produce sufficient personnel to overcome the shortfalls, it will be necessary to turn to immigration or make changes on the demand side of construction.

Approaches a) and b) are examined more fully in the following sections:

a) Alternative approaches to traditional apprenticeship

The recent Economic Council study entitled Skills and Shortages laments:

> "Apprenticeships are a primary means for acquiring many high-level blue-collar skills yet, as has been often noted, this method is not well developed in Canada, particularly in comparison with European countries."[1]

The traditional form of apprenticeship could be either modified or replaced.

Modification of traditional apprenticeship could include the following approaches taken alone or in combination:

i) Letting the apprentice proceed at his own pace and using standardized tests to determine competency at each level of the training. Students wishing to complete the program quickly might do so, providing they were able to master the subject matter and acquire the needed hours of on-the-job training.

ii) Revising the curriculum to eliminate subject matter that is now obsolete and adjusting the hours needed for on-the-job training to match the level of sophistication required.

1/ Gordon Betcherman, Economic Council of Canada, Skills and Shortages, A Summary Guide to the Findings of the Human Resources Survey, Hull, 1980, p. 18.

in today's marketplace, thereby possibly reducing the length of the training period.[1]

iii) Strengthening the linkage between high school technical or vocational training and apprenticeship training, in order to lessen the amount of institutional training required of apprentices and consequently reduce the training time.[2] Possibly credits could be given for particular programs of study in high school. The gap of three or more years between high school and apprenticeship probably could be shortened, thus providing closer ties with the high school curriculum. An additional benefit might also be lower drop-out rates since apprentices of 18 or 19 years of age may be more willing to accept the pay progression (40, 60, 80, 90% of journeyman wage rates from years one to four respectively) than would a 22- or 24-year-old who has built up income expectations and who is more likely to have other financial responsibilities.

iv) Restructuring of the program so that there would be "front-end" loading of the program with job experience following later. There could be concentration on full-time education and training with less emphasis on work experience in the first half of the program. Practical "hands-on" training during this time could be acquired through the greater use of off-the-job training centres[3], and

v) Linking the training more closely to a specific set of skills needed in the labour market.[3] This could be done

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1/ Two Ontario Community Colleges are reportedly looking into possibilities in general of reducing the apprenticeship term. For further information contact Dr. Rifki Taher, Director of Manpower Training, CEIC, Toronto.

2/ See Government of Canada, House of Commons Special Committee on Employment Opportunities for the 80's <u>Proceedings,</u> 16 July 1980, p. 24 (Testimony of N. Meltz).

3/ Approaches iv) and v) could be used to counteract the effects of cyclical instability.

by developing a series of training modules that would be followed by work experience. A modular approach would permit students to acquire certifiable levels of skill in a limited area of expertise within a certain period of time. To become a journeyman, a set number of modules would have to be completed. However, the student would be able to work in those areas of specialization covered in the modules. The students could schedule the training program to coincide with the market demand for their levels of skills and their financial situations. A limit could be established to cover the time between start and completion of the program.

Training arrangements other than the apprenticeship system of training may need to be explored. An alternative might be a co-operative type of program involving classroom instruction and practical off-the-job training, combined with work experience in a trade specialty but without the tutorial aspect found in apprenticeship. The co-operative programs in engineering offered by the University of Waterloo might serve as a model for this approach.

A seemingly unique and highly successful program for training skilled manpower is to be found in the aerospace industry in Quebec. Here a committee, comprising three management representatives, three from labour, one from the provincial government in Quebec, one from the federal government and an independent chairman, was formed in 1978 to forecast aerospace manpower requirements and recommend ways of meeting them.[1] (Appendix D) The experience of this committee might be of interest to the

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1/ The Financial Post, Special Report, "Company programs overcome skill shortage", Toronto, September 6, 1980, p. S10.

Owner/Client Councils in Ontario and Alberta and the Employers' Council of British Columbia that are in the developmental stage of organizing joint action to ensure adequate supplies of construction manpower.

However, alternatives to the apprenticeship have not necessarily been successful in preventing labour shortages. A recent newspaper article suggests that this problem exists in the auto parts industry, for instance, which has had no apprenticeship program.[1] (Appendix E)

b) Training and employment of semi-skilled specialists

The training and employment of workers as semi-skilled specialists could help solve manpower shortages in the construction industry, reduce unemployment, and provide useful training and job experience to the workers. Candidates for such training could include people from other industries or occupations as well as some who have been unemployed or underemployed construction workers. This approach has been used on the Syncrude project in the 1970's, especially for overcoming shortages of welders, and on major projects in other parts of the world.

These semi-skilled specialists would work under the supervision of journeymen and would do a narrow range of tasks, probably of a repetitive nature and free journeymen for more complex jobs.

Training could be done on an accelerated basis institutionally or on the job or in a simulated work setting. Some of the large industrial contractors especially have well-developed curricula and trained personnel who could serve as teachers. Many of these

1/ The Citizen, "Apprentice help given car plants", Ottawa, October 20, 1980, p. 27.

firms have extensive international experience in training large numbers of personnel having limited technical or academic qualifications. Alternatively, training could be done by community colleges, vocational schools, unions, or multi-party developed training.

The projects requiring these personnel should bear their fair share of the costs of this training since they will be the prime and most direct beneficiaries.

Depending upon the amount of previous training and education, the training of welders, for example, for special tasks could be accomplished in a period from two and one half to 18 months. Other types of skills would have to be adjusted accordingly. Ample opportunities should exist for persons employed in other industries with related skills or for the unskilled willing to learn and to work in the construction environment. This might provide a way for the native population and for women to gain employment in the construction industry.

Given the length of time needed to construct major projects and the lead-time available until the start of work by the highly-skilled trades, it would seem feasible to produce graduates from such a training approach who could contribute significantly to meeting the manpower needs of these projects.

On unionized projects, union certification could be given <u>only</u> for the life of the project and the unions should not have on-going responsibility for these workers. Depending upon demand in the construction industry, these semi-skilled specialists could be hired on another major project, be considered as candidates for apprenticeship, or move into another industry.

This type of training offers the advantage of being not only faster and hence less costly than that required for full-fledged journeymen, it raises the skill levels of workers who may have been unemployed or underemployed and, of course, it would speed up completion of construction projects.

The CEIC could play a major role in informing Canadians about these special training and employment opportunities and in helping those who are completing employment on projects to find employment where their training and job experience can be used to maximum advantage. Assistance could be provided by the CEIC training and mobility programs, as well as the National Job Bank.

For this approach to work, there needs to be multi-party agreement on the type of training needed, the nature of the jobs themselves, the status of these workers vis-à-vis other workers on-site and the number of such trainees required. The CEIC should take a leading role in organizing such support, as it is one of the few organizations with a national overview of major projects due for construction across Canada in this decade. This subject is dealt with in some detail in a later section of this chapter.

Training and Education - Engineers

The problems in adjusting the supply of skilled trades are just as serious for engineers. With lead-times about the same, it is important to have good forecasts of future demand. Unfortunately, in the past the levels of enrollment have been geared heavily to current demand rather than the projected demand at the time of graduation.

Students entering university in 1981 would not graduate until 1985 at the earliest and would not be considered as "qualified and minimally experienced" prior to 1987. This would be too late to meet the heavy demands expected in the years around 1985. And there is virtually no expectation that the length of time required to produce a first-degree engineer will be shortened due to the concern over standards expressed by the profession, the universities and the government. The demand for engineers with at least five years experience is expected to be much more acute than for recent graduates. Only mobility or an accelerated approach to giving recent graduates the needed experience will ease this problem.

With the shortages expected for engineers in construction in the early 1980s, particularly for the mega projects, alternative strategies should be considered. More effective use of engineering consultants is needed and some consideration should be given as well to developing a "loan" arrangement with industries having engineers that are underemployed.

Some possibilities exist to substitute engineering technicians and technologists for engineers to do some of the standardized and technical aspects of engineering. This would free engineers to do the more creative and theoretical tasks as well as project management. Perhaps programs should be set up in which graduates from the sciences or from fields of engineering in less demand could take construction engineering courses and get credit for previous studies to acquire a degree in those branches of engineering in high demand. Also, greater use may be made of other occupations, such as accounting and purchasing, to perform functions currently done by engineers.

The construction industry could assist the engineering schools in this regard by indicating more clearly its longer-term needs for engineers and by providing financial support for expansion and upgrading of engineering school facilities and staff. Some of the initiatives taken in the petroleum industry may serve as examples for the construction industry.[1]

Attention should be given to ways in which engineering schools in Canada might increase their enrollment and the resultant supply of graduates. Increases might be possible, but there is concern that the quality of education might suffer. There is concern as well for the future supply of researchers and teachers due to the serious decline in graduate level enrollment of Canadians in engineering. This is viewed as a potential problem in the United States as well.

Long-term Strategies

Counselling

As a step towards ensuring future supplies of qualified personnel for the construction industry, young people must have sound information upon which to base their career decisions. Up-to-date information on types of jobs, working conditions, income levels, and future demand/supply prospects should be readily available to high school students in the early stages of planning their careers.[2] The CEIC,

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1/ Martin Keeley, "Manpower Crisis - fact or fancy?", Canadian Petroleum, May 1980, pp. 25-28.

2/ Interviews with a small number of Canada Employment Centre counsellors and high school guidance counsellors in the City of Brantford, Ontario revealed the need for such up-to-date information and forecasts. This is not the case in all parts of the country. Provision of this type of information has received high priority in Alberta's Department of Advanced Education and Manpower and has been influential in attracting large numbers of applications to apprenticeship programs.

in conjunction with the construction industry, relevant labour organizations, and appropriate provincial departments of labour or education, should consider regular distribution of descriptive material on construction to employment and guidance counsellors who have access to potential future construction personnel. This is much less costly in financial and social terms than having to retrain workers or to bear the costs of unemployment, underemployment or job vacancies.

Productivity

The relatively low levels of productivity in the construction industry was cited as a major problem by representatives from the construction industry, buyers of construction, organized labour and government. While the problem is recognized, there is little work being done to determine the reasons or to prescribe remedies.

An increase in productivity in terms of an increase in output per worker would, by definition, contribute to reducing manpower shortages and in the process lessen the costs of training and mobility programs.

The CEIC, in concert with the Construction Industry Development Council (CIDC) and other interested parties, should consider ways of improving productivity as a means of lessening the shortages expected in some of the skilled trades and making the industry generally more efficient. Short and long-term strategies for improving productivity should be developed for the industry. Areas to be examined could include the organization of the work, labour/management and worker/supervisor relations, incentive programs, the use of new technology, and so on.

Technological Change and Factor Substitution

Technological change in construction in the 1980s is expected to be similar to that in the 1970s.

> "Rather than consisting of dramatic breakthroughs, technological change in construction tends to be gradual and includes a wide variety of individual developments in materials, equipment and methods." [1]

In the 1980s no dramatic changes in technology are expected that would reduce substantially the labour component in construction. Materials may, however, become stronger and lighter and more energy efficient. Refinements in computer technology may introduce greater efficiencies in scheduling and designing and managing information; this could have significant effects on the tasks performed by engineers and technicians and could free the engineers from some of the more standardized technical and mechanical functions. Equipment may become faster, capable of moving larger quantities and more easily maintained.

Technological change over the past thirty years, though, has changed the skill levels required for the trades. Generally speaking, the highly skilled trades (plumbers, pipefitters, electricians) have had to become more sophisticated to work with the changed technology.

The skill levels in the basic trades (carpenters, plasterers, drywall installers) have been reduced because of new materials and prefabrication, thus permitting the use of those with lower skill levels.[2] On the other hand, as more and

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1/ Economic Council of Canada, Toward More Stable Growth in Construction, Ottawa, 1974, p. 31.

2/ Bourdon, C. C. and Levitt, R. E., A Comparison of Wages and Labour Management Practices in Union and Non-union Construction, United States, Department of Housing and Urban Development, Washington, 1978, p. 6.

more attention is devoted to making buildings, both residential and commercial, more energy efficient a new class of tradesman may emerge with special skills not used extensively in the past.

To increase the flexibility of journeymen to react to alterations in occupational structure created by major changes in technology or buyer preference, it seems worthwhile to consider the merits of introducing a generic skills concept into the curriculum of the apprenticeship training, possibly in its early stages. With a common base of knowledge in the highly skilled trades, it should be possible to reduce the impact of such change through lessening the amount of retraining necessary to modify functions within the same occupation or to shift into another occupation.

B. Adjusting Demand

As mentioned at the beginning of this chapter, adjustment of supply is likely to be regarded as more appropriate than adjustment of demand in case of imbalances in manpower. Demand can, however, be adjusted by changing the scheduling of projects or by modifying projects.

Scheduling of Projects

This is, of course, usually the prerogative of the buyer of construction rather than the construction contractor. In changing the schedule of a project, the former would likely be more interested in moving it forward, but in many cases rescheduling would likely involve delaying the project. In some instances this could be costly in terms of losing competitive position in the market, for example. In other cases if the entire investment could be delayed and if the market position was not critical, postponement of a project might not be too costly.

Ideally, the forecast labour demand/supply situation for the life of the project would be included as a key ingredient from the start of the planning for the project.

Public intervention to alter the scheduling of private sector projects solely for the purpose of manpower planning could significantly alter the economic rationale of the buyer of the construction project. A question arises as to who should bear any economic losses incurred as a result of these externally imposed public actions. Is it a cost of doing business which should be borne by the individual buyer, or is it a cost which should be reimbursed out of the public or private purse? Another question would enquire into who should make and enforce such decisions.

Chart III-1 would seem to illustrate the possibility of some advantage to changing the schedule of at least one of the potential projects listed. Without knowing the market-related implications of such a move, it would seem that if the total projects could be spaced out throughout the 80s and early 90s, much more efficient utilization of manpower would result with resultant substantial savings in the cost of moving extra workers in and training them.

Modification of Projects

At the design stage of the project modification of the structure and the way it is constructed may be a possibility to lessen the effects of shortages of labour. These modifications might include:

a) the greater use of prefabricated components built off-site, perhaps in other parts of Canada where manpower

shortages do not exist; or

b) alteration of the design to permit greater use of equipment or the use of methods which are less labour intensive.

Modifications might also be more substantial, as in the case of the proposal to consider small-scale oil sands plants instead of the mega projects.[1]

1/ Daily Commercial News, "Alberta may test small-scale oil sands plants", Toronto, September 8, 1980, p. A1.

Chapter IV

Part III

The Role of the Canada Employment and Immigration Commission

The CEIC has an important role to play in helping the construction industry, indeed all major industries, to match the supply of and demand for qualified, skilled personnel. To this end the most important functions are co-ordination and leadership in the determination of needs on a national basis and the provision of policies and programs to meet them. Given its present structure and focus, the CEIC is not well organized to fulfill these objectives. As a result, it is recommended that new lines of communication and responsibility be established and some new functions be incorporated.

The CEIC, currently organized primarily on a functional basis (immigration, training, mobility, job creation, et cetera), has, in most cases, construction specialists in these functional areas both at national headquarters and in the regional offices. However, the linkages between the functional areas for each industry are for the most part ad hoc and informal. What is needed is a construction industry co-ordination and research function within national headquarters with formal linkages to the CEIC's construction specialists working in the functional areas at national headquarters and at regional offices throughout Canada. We shall refer to such an arrangement as the Construction Bureau. It would be one of the major users of data generated by the Personnel Information System. Based on the latter and other sources of information the Bureau would recommend policies and procedures for dealing with projected imbalances between supply and demand for skilled construction personnel, co-ordinate internal CEIC operations relating to construction, and liaise with external bodies interested in construction activity. The Bureau would also conduct research and engage in short, medium and long-term planning on construction manpower.

Chart IV-1 shows the structure of the proposed Construction Bureau and its links with the functional sections of CEIC at national headquarters and in the regional offices. Staffing could likely be achieved to a considerable degree through the redeployment of present personnel.

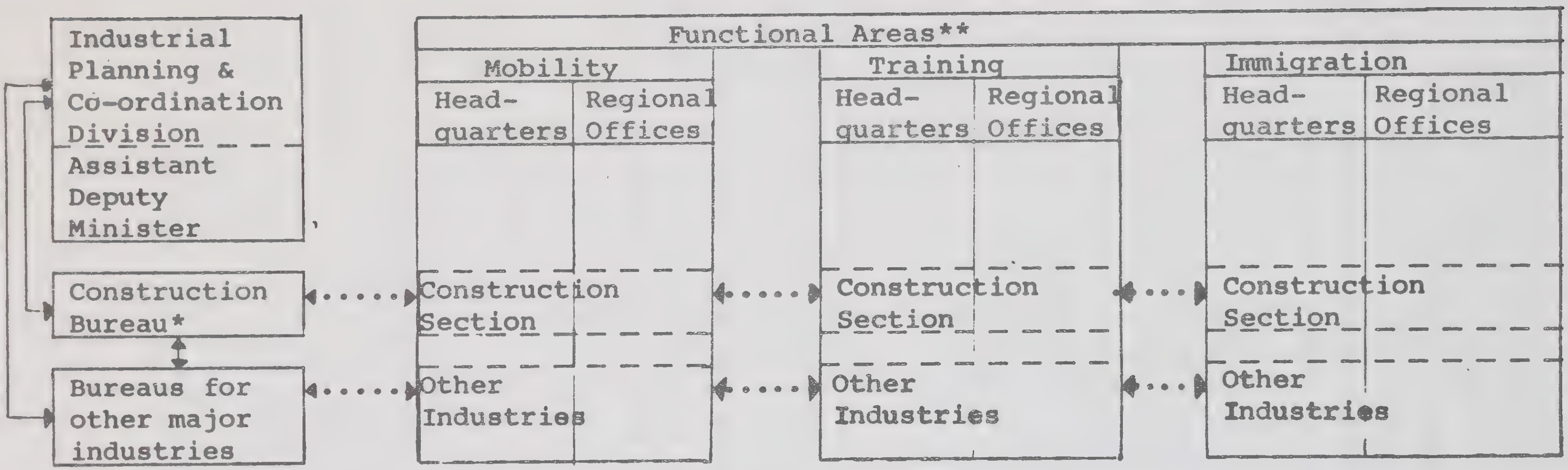
Similar bureaus probably should be considered for other industries and this possibility is included in the chart. The Construction Bureau should maintain regular contact with the bureaus that are established for other major industries. Such common issues as labour supply/demand imbalances, inter-industry and inter-occupational mobility, new training approaches, and career and employment counselling should figure prominently in these liaisons.

One of the first tasks of the Construction Bureau should be to provide the industry with better information about the policies and programs of CEIC. The CEIC offers a considerable number of programs and services that could benefit the construction industry. However, most of the published information available refers to specific programs separately and is designed for all readers but not specifically the construction industry. The need for this information becomes very important in the context of the large number of major projects planned for this and the following decade.

A greater awareness by this industry of CEIC programs and policies available to them, and possibly a higher utilization of CEIC services, should result through better communication to the industry by the CEIC. Two initiatives would prove very useful in this regard. First, a booklet outlining specifically for the construction industry the major goals, objectives, policies and programs of the CEIC as directed to this industry. The rationale for the above should be explained and the way the policies and programs operate should be described. For instance, it might help to dispel concern or doubts about immigration policies if the industry were to learn the steps involved in the approval process for bringing foreign nationals into Canada as permanent immigrants or temporary workers. As the next step, CEIC personnel should address the industry at seminars or conventions at both the national and local level.

Chart IV-1

PROPOSED CEIC ORGANIZATIONAL STRUCTURE



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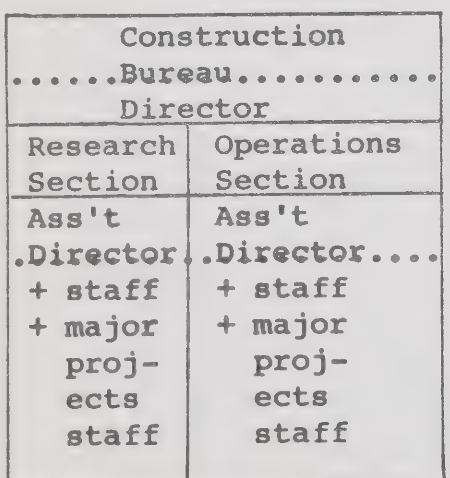

**Other functional areas, besides those listed include: unemployment insurance; employment/career counselling; job creation; special needs clients services; strategic planning and analysis; etc.

Another important role for the Construction Bureau would be to develop regularized and structured channels of communication with other departments in the federal government actively involved with the construction industry. Through these contacts, a network could develop that would produce a strong federal presence in the industry. Some of the departments and agencies that would be key to the operation of this network would be, for example: CEIC (manpower), Industry Trade and Commerce (materials, investment, machinery and equipment), Labour (collective bargaining and labour regulations), Public Works (public capital investment), National Research Council, Division of Building Research (technology and technological change), and Canada Mortgage and Housing Corporation (all aspects of residential construction). The identification of the relationships prevailing among the above topics could have considerable impact on the construction industry, for example, on the mutual effects of manpower and material shortages on construction scheduling.

Within the Construction Bureau special staff should be assigned to deal exclusively with major construction projects (e.g., above 150 million constant 1980 dollars). This was shown in Chart IV-1 and it was indicated that both research and operational functions would be involved. The major projects group could play an extremely important role in view of the considerable number of large-scale projects scheduled for Canada in this and the next decade. Accordingly it would seem advisable that some staff of this group be located in those areas where decisions are being made regarding major projects and where the planning of them is taking place. The major projects group would have primary responsibility in CEIC for proposing national policies and procedures related to manpower planning for the major projects and for co-ordinating CEIC activities for these projects. In view of the number of large and geographically diverse projects planned, it is essential that all parties involved in their construction know what is expected of them according to CEIC policy and what they can expect from CEIC in operational and policy terms. Specifically the major projects group should be responsible for:

1. Recommending to the department the types of services and policies needed for the staffing of the major projects.
2. Informing the buyers, contractors and unions of the services and policies provided by the CEIC.
3. Providing assistance in the development of manpower plans for each project and the monitoring of these plans in the light of CEIC policy.
4. Comparing manpower plans of the major projects, one to another and, acting in conjunction with the Construction Bureau, to the probable manpower requirements of other types of construction to ascertain as soon as possible the nature and extent of future supply/demand imbalances and/or bottlenecks.
5. Recommending solutions for these problems to CEIC and others.
6. Co-ordinating those activities and programs included in the agreed-upon solutions, within the CEIC and with other interested parties.

Improved co-ordination among the different programs should be accompanied by more participation by the regional offices in the planning and budgeting stages and greater flexibility in the flow of funds amongst the programs. This should help the regional offices to address the problems of the industry more quickly and more precisely with the right programs and the right level of funding.

Chapter V

CONCLUSIONS AND RECOMMENDATIONS

The main findings and conclusions of the study together with recommendations are listed below. Page references indicate where more detailed discussion begins in the preceding chapters.

Conclusions	Page No.
- A marked shift is taking place from residential to non-residential construction. Within the residential sector major renovation is increasing sharply.	I.1
- Growth in construction will be concentrated in Alberta and Saskatchewan.	I.4
- There is a substantial increase in the number of large-scale industrial projects being planned. They are dispersed throughout Canada and will require considerable numbers of skilled personnel in their construction.	I.7
- Substantial shortages of pipefitters, welders, boilermakers, millwrights, and engineers are forecast during the 1980s. The time the shortages will be most severe will be influenced largely by the numbers, timing, and location of the large-scale projects.	III.1
- Though the shortages will be due mainly to the large projects, for the most part the latter may be able to attract workers as needed and shift the main shortages to other private and public work projects.	III.1

Page No.

- Comprehensive data on supply of and demand for skilled construction personnel are not available. The provinces of Nova Scotia, Saskatchewan and Alberta, as well as the United States, have however, initiated manpower information systems that could serve as a base from which a national system could be developed for Canada. IV.1

Recommendations

- The first recommendation calls for the establishment of a Personnel Information System that would provide short, medium, and long-term projections of both demand for and supply of skilled construction personnel by occupation and region. Initiative for inaugurating the System should be taken by the Canada Employment and Immigration Commission, but once established it should function independently under the direction of all major parties in construction. IV.5

- It is recommended as well that new lines of communication and responsibility be established in the Commission to provide better co-ordination on a national basis of information on the supply of and demand for skilled construction personnel. IV.40

- A number of other recommendations emphasize adjusting the supply of skilled personnel and include strategies for both the short-term and longer-term:

Short-term

- Improve the incentives for, and remove the impediments to, mobility, including geographical, inter-industry, inter-sectoral, and inter-occupational. IV.16

Page No.

- Continue to permit immigrants to enter Canada, mostly on temporary employment authorizations, and when other measures are not meeting demand satisfactorily. IV.21

- Regard overtime as a traditional solution to manpower shortages, but recognize the inflationary effects of extensive overtime wages and the potential negative effect on productivity if it is used to excess. IV.22

Longer-term

- Introduce standardized training and accreditation for apprentices throughout Canada. This would improve their mobility to fill job vacancies in other provinces as well as improve their chances of being able to complete their training during periods of slack demand in certain regions. IV.22

- Consider ways of modifying the traditional form of apprenticeship training to shorten the period required for certification. IV.23

- Train semi-skilled specialists to solve both short and longer-term manpower shortages, reduce unemployment, and up-grade the skills of workers. IV.30

- Encourage the use of more technologists and technicians to relieve the shortage of engineers in construction. IV.32

- The Canada Employment and Immigration Commission, together with the Construction Industry Development Council, should explore various possibilities for improving productivity, ranging from different work arrangements and management approaches through to the use of new technology. IV.35

APPENDICES

A - 1	Housing Construction Expenditures by Province, 1979-1990
- 2	Non-residential Construction Investment by Province, 1979-1990
B - 1	Total Value of Construction by Type, 1970 and 1979
- 2	Total Value of Construction by Province, 1970 and 1979
C	Construction Personnel Information Systems
- 1	The Owner-Client Council of Ontario
- 2	The Winnipeg Construction Association
- 3	The United States Department of Labour
- 4	The Alberta Department of Advanced Education and Manpower
- 5	The Canada Employment and Immigration Commission, Saskatchewan Region
- 6	The Nova Scotia Department of Labour *et al.*
- 7	The Construction Industry Review Panel and the Ontario Ministry of Labour
- 8	Public Works Canada *et al.*
D	Company Programs Overcome Skill Shortage
E	Apprentice Help Given Car Plants

Appendix A-I

HOUSING CONSTRUCTION EXPENDITURES
BY PROVINCE
MILLIONS OF 1971 DOLLARS

	1979.00	1980.00	1981.00	1982.00	1983.00	1984.00	1985.00
TOTAL CANADA	4331.42	3568.69	4124.40	4550.08	4510.82	4509.67	4316.48
NEWFOUNDLAND	71.60	79.54	91.85	106.80	118.99	127.46	130.50
PRINCE EDWARD ISLAND	27.71	23.77	48.01	60.53	52.79	42.97	41.45
NOVA SCOTIA	114.95	114.97	139.07	165.06	173.13	170.58	170.16
NEW BRUNSWICK	116.20	104.70	183.73	239.65	237.74	220.94	211.00
QUEBEC	1140.82	1107.05	899.34	845.32	833.03	954.61	988.11
ONTARIO	1439.50	1318.90	1606.72	1975.92	2055.52	1948.82	1860.49
MANITOBA	170.11	145.75	214.82	263.62	253.80	235.24	220.45
SASKATCHEWAN	246.13	182.30	206.50	249.33	260.50	269.35	271.91
ALBERTA	849.11	572.76	563.21	563.96	533.38	527.14	518.94
BRITISH COLUMBIA	646.95	688.73	699.18	636.83	547.98	488.76	489.14

	1986.00	1987.00	1988.00	1989.00	1990.00
TOTAL CANADA	4132.79	4163.32	4310.71	4344.26	4467.43
NEWFOUNDLAND	128.58	117.35	106.15	101.73	100.44
PRINCE EDWARD ISLAND	48.14	57.67	56.51	46.99	46.20
NOVA SCOTIA	164.16	157.56	153.62	149.47	147.13
NEW BRUNSWICK	206.39	207.71	212.40	214.15	216.04
QUEBEC	956.95	845.84	720.20	606.01	501.60
ONTARIO	1838.09	1934.59	2111.01	2212.53	2332.94
MANITOBA	215.31	225.79	244.60	269.80	300.26
SASKATCHEWAN	257.30	248.17	243.23	230.49	218.02
ALBERTA	457.46	459.66	503.43	514.69	533.76
BRITISH COLUMBIA	463.44	439.73	439.49	439.00	428.90

Source: Informetrica Ltd. Provincial Construction Reference Forecast, Ottawa, July,1980, Table D-I

Appendix A-2

NON RESIDENTIAL CONSTRUCTION INVESTMENT
BY PROVINCE
MILLIONS OF 1971 DOLLARS

	1979.00	1980.00	1981.00	1982.00	1983.00	1984.00	1985.00
TOTAL CANADA	11442.70	12118.27	12342.78	12975.19	14137.05	15166.70	16408.59
NEWFOUNDLAND	224.03	241.12	313.12	467.36	501.64	525.88	487.83
PRINCE EDWARD ISLAND	37.61	38.68	38.28	35.92	38.57	39.16	40.95
NOVA SCOTIA	301.44	323.47	334.31	342.35	370.96	369.44	373.15
NEW BRUNSWICK	287.77	245.72	247.39	221.12	236.69	256.63	267.53
QUEBEC	3240.32	3155.54	3105.45	3290.76	3536.82	3852.35	4225.99
ONTARIO	2589.03	2652.64	2688.07	2849.61	3068.51	3219.44	3422.88
MANITOBA	373.03	380.49	362.69	370.30	374.92	384.27	400.15
SASKATCHEWAN	525.50	578.93	591.50	628.81	687.12	744.29	810.29
ALBERTA	2412.29	2915.42	3056.42	3193.23	3505.18	3936.25	4376.19
BRITISH COLUMBIA	1451.69	1586.26	1505.55	1575.73	1736.65	1838.99	2003.62

	1986.00	1987.00	1988.00	1989.00	1990.00
TOTAL CANADA	17471.54	18168.97	18814.08	20251.04	21685.49
NEWFOUNDLAND	437.91	417.19	401.64	453.84	512.36
PRINCE EDWARD ISLAND	40.73	37.78	34.72	38.69	41.40
NOVA SCOTIA	369.62	354.26	337.78	358.43	374.78
NEW BRUNSWICK	277.84	276.96	273.51	294.69	314.26
QUEBEC	4594.39	4939.13	5206.15	5700.22	6149.26
ONTARIO	3548.07	3528.81	3488.29	3714.34	3919.77
MANITOBA	416.47	430.62	439.82	461.34	489.40
SASKATCHEWAN	876.49	941.19	1014.36	1108.35	1217.97
ALBERTA	4739.61	4996.03	5239.21	5606.25	5964.44
BRITISH COLUMBIA	2170.43	2247.01	2298.60	2514.89	2701.85

Source:Informetrica Ltd., Provincial Construction Reference Forecast, Ottawa, July,1980, Table E-I.

Appendix B-1

Total Value of Construction Work Performed in Canada
Comparison of 1970 and 1979 Distributions
By Type of Construction

Type of Construction	1970 Total Value $ Million	Per Cent of Total	1979 Total Value $ Million	Per Cent of Total
Total Building Construction	8,098	58.8	24,438	57.7
Residential	4,008	29.1	14,153	33.4
Industrial	1,000	7.3	1,945	4.6
Commercial	1,287	9.3	4,825	11.4
Institutional	1,330	9.7	1,966	4.6
Other	473	3.4	1,549	3.7
Total Engineering	5,683	41.2	17,933	42.3
Marine	145	1.1	250	0.6
Road, Highway & Aerodrome Construction	1,280	9.3	3,427	8.1
Waterworks & Sewage Systems	488	3.5	1,956	4.6
Dams & Irrigation	58	0.4	189	0.4
Electric Power Constr.	1,224	8.9	4,073	9.6
Railway, Telephone & Telegraph Constr.	568	4.1	1,663	3.9
Gas & Oil Facilities	1,094	7.9	4,197	9.9
Other	826	6.0	2,177	5.1
TOTAL CONSTRUCTION	13,781	100.0	42,371	100.0

Source: Statistics Canada, Construction in Canada.

Appendix B-2

Total Value of Construction Work Performed in Canada
Comparison of 1970 and 1979 Distributions
by Province

	1970		1979	
	Total Value $ Million	Per Cent of Total	Total Value $ Million	Per Cent of Total
Newfoundland	415	3.0	808	1.9
Prince Edward Island	46	0.3	164	0.4
Nova Scotia	485	3.5	1,122	2.6
New Brunswick	340	2.5	1,078	2.5
Quebec	2,789	20.2	9,395	22.2
Ontario	4,985	36.2	11,538	27.2
Manitoba	695	5.0	1,452	3.4
Saskatchewan	476	3.5	2,047	4.8
Alberta	1,710	12.4	9,051	21.4
British Columbia	1,842	13.4	5,715	13.5
CANADA	13,781	100.0	42,371	100.0

Source: Statistics Canada, Construction in Canada.

Appendix C

Appendices C-1 - C-8 describe some of the approaches taken in several parts of Canada and in the United States to forecast the supply and demand of skilled personnel in the construction trades. Of the eight examples, three forecast only demand; i.e., the ones prepared by:

The Owner-Client Council of Ontario C-1

The Winnipeg Construction Association C-2

The United States Department of Labour. C-3

and the other five both supply and demand; i.e., those of:

The Alberta Department of Advanced Education and Manpower C-4

The Canada Employment and Immigration Commission, Saskatchewan Region C-5

The Nova Scotia Department of Labour et al. C-6

The Construction Industry Review Panel and the Ontario Ministry of Labour. C-7

Public Works Canada et al. . . . . C-8.

All of the above agencies are still operational, except for C-7 and C-8.

In Ontario an econometric model is currently being developed by the provincial government on an all-industry basis, which should have the capacity to provide forecasts of aggregate construction labour demand and supply. These agencies, except Public Works Canada et al., have published actual forecasts, though in some cases their models are still being developed or refined.

Appendix C-1

THE OWNER-CLIENT COUNCIL OF ONTARIO*

The Owner-Client Council of Ontario (O.C.C.O.) is composed of Canadian corporations having substantial construction interests within Ontario.

The Council has developed a construction manpower demand forecast for the Province of Ontario. Based upon procedures developed by Sarnia owner-clients and the local construction association, the Council's annual survey and forecast is now an established information source for member companies, governments, contractor groups and craft unions. The survey covers organizations responsible for some 70 per cent of all industrial and electric power construction in Ontario.

Attached is an example of the information prepared by the O.C.C.O. from its survey.

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* This description is reproduced from the booklet, The Owner-Client Council of Ontario, p. 4.

C-1.2

Type of Construction

Major Maint. ( )   Generatn. ( )   Other:
Hvy. Indstl. ( )   T'mission. ( )   ________
Petrochem. ( )   Warehse. ( )   ________

The Owner-Client Council of Ontario

PREDICTED DEMAND for CONSTRUCTION MANPOWER

OWNER: TOTAL - ONTARIO

REGION No. ALL

CONSTRUCTION TRADE	1980			1981				1982			
	2nd.Qtr	3rd.Qtr	4th.Qtr	1st.Qtr	2nd.Qtr	3rd.Qtr	4th.Qtr	1st.Qtr	2nd.Qtr	3rd.Qtr	4th.Qtr
INSULATORS	306	335	276	285	354	345	401	426	480	422	346
BOILERMAKERS	815	688	628	460	686	517	539	542	782	659	620
BRICKLAYERS	315	349	174	102	311	148	165	229	239	264	132
CARPENTERS	1228	1377	1023	824	1051	1132	1109	940	1061	941	847
CEMENT MASONS	150	192	139	89	140	176	138	105	144	146	85
ELECTRICIANS	2079	2225	2325	1697	2045	2221	2434	2284	2443	2159	2095
IRONWORKERS	1086,	1051	996	999	1220	1064	1113	1072	1085	1131	886
RODMEN	131	124	89	80	113	147	133	120	136	201	148
LABOURERS	2196	2253	1867	1620	2205	2180	2170	2238	2483	1928	1714
MILLWRIGHTS	349	453	449	504	512	481	479	560	728	686	544
OPG. ENGINEERS	487	485	443	424	714	654	642	580	587	421	403
PAINTERS	339	401	340	226	374	424	325	324	430	523	327
PIPEFITTERS	2348	2462	2204	2017	2423	2374	2459	2593	2847	2256	1997
PIPEWELDERS	443	472	427	316	418	391	427	515	587	524	282
SHEET METAL WKRS.	216	284	246	224	250	257	256	261	237	233	180
TEAMSTERS	334	357	366	311	452	422	393	373	411	371	345
Unclassified	887	911	618	467	541	412	382	347	415	409	334
TOTALS	13709	14419	12610	10645	13809	13345	13565	13509	15095	13274	11285

Appendix C-2

THE WINNIPEG CONSTRUCTION ASSOCIATION*

Following initial meetings between representatives of the Winnipeg Construction Association, the building trades unions and the Ministers of Economic Development, Government Services, Education and Finance, it was agreed that preliminary material would be drawn up by WCA and the Department of Government Services.

The final format for the information was agreed to in January, and government representatives began to develop specific information with regards to construction intentions. It was agreed that various government departments, as well as Crown agencies purchasing construction services, would contribute information to the program. At the same time WCA agreed to develop comparable information from the private sector.

Once the total information package is complete, the industry will have an opportunity to learn of all construction projects and plans within the province for up to twelve months, and in some cases longer, and to plan their company expansions, annual activity, and bidding patterns accordingly. At the same time the advance knowledge that a number of construction projects will be available in Manitoba will encourage skilled tradesmen to remain in the province.

It is planned to update the information quarterly on a continuing basis. Where possible, indications will be given of the time of year of the tender call, the specific month if it is known, and the specific period of the month if it can be provided. The particular trades involved in each project will also be indicated.

* This description is reproduced from: The Mancon Report (March/April 1980), prepared by the Winnipeg Construction Association, and from the bulletin on 1980-81 survey results.

SOURCES OF STUDY

A. - MANITOBA ARCHITECTURAL & DESIGN ENGINEERING FIRMS

B. - PROVINCE OF MANITOBA

- Department of Education
    - Frontier School Division
    - University Grants Commission
- Department of Government Services
- Department of Natural Resources

\- Corporations/Boards Etc.

- Agricultural Service Centre Agreement
- Manitoba Health Services Commission
- Manitoba Hydro
- Manitoba Telephone System
- Manitoba Water Services Board
- Public Schools Finance Board

NOTE RE GOVERNMENT PROJECTS:

The projects outlined herein do not include work currently underway for which money is flowing into the industry. Nor do they include projects already awarded but not yet started. The list involves NEW construction projects slated for the future. The list will be updated quarterly to remove projects since awarded, to add new approved projects, and to include in the future those projects originating in the private sector of Manitoba's economy.

CODE FOR WORK INCLUDED IN MAJOR CONSTRUCTION PROJECTS

(Based on U.C.I. Index)

2	Sitework (ie., Demolition, Excavation, Foundations, Etc.)
3	Concrete
4	Masonry
5	Metal (including Structural Steel)
6	Wood and Plastic (Carpentry and Woodwork)
7	Thermal and Moisture Protection
8	Doors and Windows (including Curtain Walls)
9	Finishing (ie., Painting, Plastering, Tilework, etc.)
11	Equipment (including Food Service Equipment)
14	Conveying Systems (including Elevators and Escalators)
15	Mechanical
16	Electrical
17	Earth Moving
18	Pipeline Installation

CODE FOR CONSTRUCTION COST ESTIMATE RANGES

A. Over $5,000,000.00

B. $750,000.00 TO $5,000,000.00

C. $100,000.00 TO $1,000,000.00

D. Under $125,000.00

PROJECTION OF GOVERNMENT AND PRIVATE SECTORS CONSTRUCTION PROJECTS

1980/81

PROJECT NAME	LOCATION	TENDER CALL	TIME TO COMPLETE	SIZE OF PROJECT	TRADES INVOLVED	DEPARTMENT
1. St. Pierre Forcemain Renewal & Lagood Expansion	St. Pierre, Man.	Aug/80		C	17,18	Dillon Const.
2. Claude Neon Bldg.	Winnipeg, Man.	Aug/80	8 mos.	B	All	Claude Neon
3. Add. to R.J. Waugh School	Carberry, Man.	Aug/80	6 mos.	C		School Division
4. Prefab-Modular	Resolute Bay	Aug/80	unknown	C		
5. Passenger Shelter	Spence Bay, NWT	Aug/80	Seasonal	C		
6. 60-Unit Apartment St.Anne's Rd.	Winnipeg, Man.	Aug/80	1 year	B	All	Crystal Builders
7. The Pas Personal Care Home	The Pas, Man.	Aug/80	1 year	B	All	The Pas Indian Band
8. Add. Shell Oil Office	Winnipeg, Man.	Aug/80	2 mos.	C	All	Shell Oil Co.
9. Add. to Morris Collegiate	Morris, Man.	Aug/80	8 mos.	C	All	Dept. of Education
10. Selkirk Care Home	Selkirk, Man.	Aug/80	9-10mos		All	Idell Properties
11. School for the Deaf Fire & Safety Upgrading Phase 3.	Winnipeg, Man.	Aug/80	1 year	C	6,8,9,15,16	Government Services
12. Headingley Correctional Institute - Water Supply System	Headingley, Man.	Aug/80	1 year	B	2,15,16-	Government Services
13. Water Treatment Plant Expansion	Carman, Man.	Aug/80	2 mos	C	All	Dept. of Agriculture
14. Health Sciences Centre Women's Centre Renov.	Winnipeg, Man.	Aug/80	16 mos	B	All	MHSC

Appendix C-3

UNITED STATES DEPARTMENT OF LABOR

Background and Description of the System

The Construction Labor Demand System (CLDS), operated by the United States Department of Labor, forecasts the demand for construction tradesmen by trade at various levels of geographical disaggregation in the United States. This system uses two separate approaches for forecasting demand, depending upon the nature of the construction projects themselves. There is one approach for construction projects in the non-energy sector and another for those in the energy sector.

The following long quotations present the background of CLDS and describe the approach used for forecasting demand for labour in the non-energy sector.*

> "The construction industry, because of its importance to the economy and record of performance, has always been the focus of public policy concern. Rates of unemployment among construction workers are double the average for the nonagricultural work force.[1] Work stoppages in the construction industry caused 20 percent of all hours lost in American industry during the period 1974-1976,[2] while construction workers constituted only six percent of total employment during that period.[3] Productivity growth in the construction industry is generally believed to lag behind the overall average, although reliable indices of productivity are difficult to construct. Construction cost increases have in recent years outstripped the general cost-of-living index.[4]
>
> Policy makers recognize that national statistics are inadequate guides to monitoring local variations in construction demand; to answer the need for detailed information on the current state of the industry, work was begun in 1976 on the Construction Labor Demand System.
>
> 1/ U.S. Bureau of the Census, *Statistical Abstract of the United States: 1978* (99th Ed.), Government Printing Office, Washington, 1978, Table 672, p. 41.
>
> 2/ *Idem.*, Table 704, p. 433.
>
> 3/ *Idem.*, Table 664, p. 407.
>
> 4/ For a more extensive review of recent trends in the industry, see *Seasonal and Cyclical Fluctuations in Construction Activity, Employment and Unemployment*, Construction Labor Demand System, U.S. Department of Labor, Washington, 1979."

*This description is reproduced from: Institute for Defense Analysis (R.W. Thomas and H.O. Stekler), A Regional Forecasting Model for Construction Activity, Washington, 1980, pp. 1-7,9,10,13-24.

"A. THE CONSTRUCTION LABOR DEMAND SYSTEM

A comprehensive system to provide detailed forecasts of construction activity and labor demand was recommended by John Dunlop and D. Quinn Mills, noted authorities on labor relations in the construction industry.[1] When Dr. Dunlop became Secretary of Labor, he directed that a feasibility study of a computerized construction information and forecasting system be performed. Based on the findings of that study,[2] work on the system was begun as a cooperative effort of the Department of Labor, the Department of Energy, and the Tennessee Valley Authority. System management was the responsibility of the Department of Labor, while the other agencies contributed valuable data, staff support, and support for outside contractors working on the various system components.

1. <u>System Design Considerations</u>

It was recognized at the outset that the system would require years to implement, and precise system requirements could not be fully foreseen in the original design. Thus a modular approach was adopted, with various parts of the system becoming operational as their development and testing was completed. Key elements which the system would require included (1) data on construction projects underway throughout the country, (2) data on the duration of construction projects and the pattern of progress toward completion, and (3) data on the labor requirements associated with different types of construction. The early system was designed to access these data where they

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[1] J.T. Dunlop and D.Q. Mills, "Manpower in Construction: A Profile of the Industry and Projections to 1975," *The Report of the President's Commission on Urban Housing,* (Washington, Government Printing Office, 1968).

[2] *Feasibility Report for Construction Labor Manpower Demand Forecasting System for U.S. Department of Labor,* National Association of Home Builders and NAHB Research Foundation, Washington, (September 1975).

"existed and gather it where they did not.[1] Work was begun on a data base system for maintaining, updating, and accessing the needed information.[2]

2. Methodology of CLDS

The method by which the CLDS generates forecasts of construction activity and labor demand is based on the structure of the industry. Of critical importance is the operation of the labor market for construction workers.

a. The Construction Labor Market

The labor market for construction workers operates in patterns which are unique to that industry. Any analysis of the construction labor market should begin with a description of the craft system.[3] The persistence of the tradition of organizing construction workers into crafts according to the tasks they perform, and the unwillingness of workers to assume tasks traditionally allocated to another craft lead to rigidities in the structures of construction technologies which are not present in most other industries. Local labor shortages in a single craft may delay projects and add to total costs. Conversely, excess labor supply in a given craft is not eliminated by assigning workers to other tasks. These rigidities are embodied in labor contracts between contractor associations and the building trades unions, where the latter are an important force. However, the traditions of the craft system predate the

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[1] U.S. Department of Labor, Construction Manpower Demand System, "Analysis of CMDS Data Requirements and Potential Services," PRC Data Services Co., McLean, VA (September 1976).

[2] U.S. Department of Labor, Construction Manpower Demand System, "CMDS System Design," PRC Data Services Company, McLean, VA (December 1976).

[3] Foster M. Burton, "A Regional Model of the Construction Industries," Doctoral Dissertation, University of Pittsburgh, 1972, University Microfilm International, Ann Arbor, MI and London, England, 1978, p. 21.

"unions, and are also evidenced (to a lesser extent) by non-union workers.

Other factors which tend to differentiate the construction labor market include the transitory nature of the work, the localized market for the product, and the typical small size of firms within the construction industry.[1] For most workers, employment tenure is only for the life of a single project.[2] Since the product of the industry is immobile, local labor surpluses cannot be eliminated by exporting the project to other regions. Firms typically do not maintain an inventory to smooth variations in demand. Finally, the small scale of the typical firm acts as a barrier to innovation, and limits the ability of the contractor to challenge established labor practices.[3]

b. Implications for Forecasting System Design

The local character of both the demand for construction activity and the market for construction labor means that, to be useful, *any forecasting system must provide very detailed regional forecasts.* National analyses mask the considerable variation in regional supply/demand imbalances. Even in the local labor market, shortages may appear in the supply of particular crafts, while workers in other crafts are unemployed. Thus, *forecasts are required for individual craft specialities,* not simply for aggregate construction employment.

This requirement generates another. The mix of construction crafts on a job varies considerably with the type of construction activity; thus, accurate and detailed forecasts of

---

[1] *Idem.*, p. 23.

[2] More specifically, employment is for only that portion of a project's duration that their specific skills are required. This may be only a few days. Foremen and skilled operating engineers tend to exhibit greater stability of employment, because of the scarcity of their skills.

[3] For additional discussion of industrial relations in construction, see Dunlop and Mills, *loc. cit.*, as well as Burton, *loc. cit.*

"craft labor demand must be based on *detailed forecasts of activity by construction type.*

c. <u>Forecasting Labor Demand Based on Knowledge of Projects Started</u>

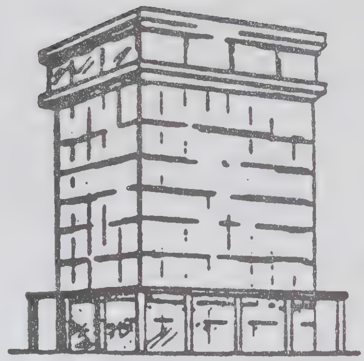
As originally envisioned, the CLDS would provide estimates of total work hours demanded, by craft, for specific types of construction in local labor market areas down to the county level. To generate such an estimate, is was necessary first to determine the value of construction activity in the area. Given the structural rigidities in the use of different crafts, activity values can be multiplied by coefficients reflecting labor requirements per unit of value to yield estimates of total labor requirements by craft. These labor requirements vectors vary with the type of project, its geographic location, and the stage of progress toward completion. (Thus, labor requirements per $1000 of value tend to be higher in the South than in the West, and are higher for multistory commercial buildings than for residential construction. Also, the demand for painters is largest near the end of the project, while reinforced concrete workers are mainly required in the first stage of construction.)

Estimates of construction activity in a given period of time are based on projects underway in that period. Individual projects are categorized by type of construction and cost of project. The expected duration of construction and progress pattern for that project are determined and applied to yield estimates of activity for each month of construction.

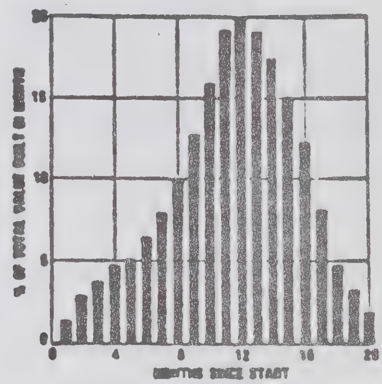
Figure 1 illustrates the labor demand forecasting process of the CLDS. In the hypothetical example shown, a government office building is recorded in the CLDS project file, with construction starting in January 1980 (Step 1). The total project cost is expressed in constant (1975) dollars, using a construction cost index appropriate to this type of building. The period

I. DETERMINE PROJECT CHARACTERISTICS

TEN STORY OFFICE BUILDING
EST. VALUE: $7,000,000 (1975 $'s)
START OF CONST: JANUARY, 1980
DURATION OF PROJECT: 20 MONTHS

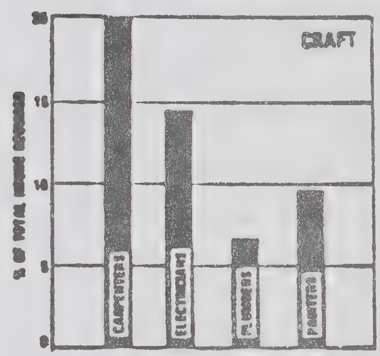


II. DISTRIBUTE ACTIVITY OVER LIFE OF PROJECT

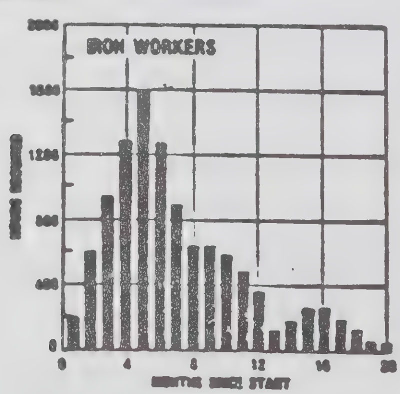


III. DETERMINE LABOR HOURS
REQUIRED FOR EACH CRAFT

$$0.04325\left(\frac{\text{HOURS}}{\$}\right) \times \$7,000,000 = 302,750 \text{ HOURS}$$



IV. DISTRIBUTE CRAFT HOURS OVER LIFE
OF PROJECT



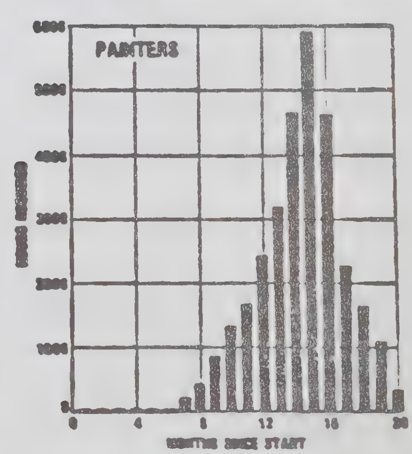


Figure 1: DETERMINATION OF LABOR HOURS AND ACTIVITY FROM PROJECT DATA

"of construction is estimated at 20 months, and the proportion of total value put in place each month is estimated (Step 2).

Labor requirements for each of the labor crafts involved in this project are determined (Step 3). The project used in the example would require a total of 302,750 hours (the equivalent of 95 people working continuously on the project for 20 months). Finally, the distribution over time of labor utilization is estimated for each craft (Step 4). The Figure shows the pattern of utilization for two crafts, reinforcing iron workers and painters. The latter group's services are required only in the final months of construction.

d. System Reporting Capabilities

Once labor hours and value of activity are estimated for each project over its lifetime, they may be aggregated over all projects within the geographic area and time period desired by the user. Through its ONLINE subsystem, CLDS provides the capability for the user to specify the geographic region of the report by combining counties, Standard Metropolitan Areas, BEA Economic Areas, or states. Data may be aggregated from monthly figures to quarterly or annual totals. The span of time covered by a report is also a user-determined parameter.

These ONLINE reports may be modified by the user to restrict the report to only certain types of construction or particular crafts. Thus each report may be tailored to present only the information required for analysis. [. . .]

Although the above characteristics make the ONLINE system a valuable tool for detailed, local analysis, it is not an efficient tool for comprehensive reports dealing with the nation as a whole. A separate system, SPECIAL REPORTS,[1] exists to

[1] See Construction Labor Demand System, *Detailed System Specifications*, PRC Data Services Company, McLean, VA (February 1979) for a complete description of the ONLINE and SPECIAL REPORTS subsystems.

"produce reports for *all* geographic areas and construction types at reasonable cost. The SPECIAL REPORTS system processes and tabulates data for all construction types, crafts and regions. These reports are available for BEA Economic Areas (183), states (51), Federal R ons (10), Census Regions (4), and the entire nation (1). A sample page is shown as Figure 3.

B. FORECASTING WITH CLDS

The ability to project future employment trends is an important element of CLDS. On a project-by-project basis, labor requirements can be projected for the remaining life of any project. Thus, long-lived projects, such as power plants and new industrial facilities, enjoy an extended forecast of labor requirements based on knowledge of projects currently underway.

A difficulty emerges, however, when comprehensive forecasts of employment are desired for all types of construction. Construction duration varies from as little as four months to more than six years, depending on the type of construction and scale of project. Thus, comprehensive forecasts based only on actual project data would inevitably underestimate total labor requirements by ignoring projects which would begin during the forecast period.

[. . .]

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(AS OF JANUARY 1978)

TYPE CONSTRUCTION 821 - OFFICE BUILDINGS

B E A NO 083 -- CHICAGO, IL

CRAFT	01/79	02/79	03/79	04/79	05/79	06/79	07/79	08/79	09/79	10/79	11/79	12/79
01 ASBESTOS WORKERS (INSULATORS)	21212	22338	23053	22590	23418	23345	25440	27045	29457	29504	31885	31870
02 BOILERMAKERS	0	0	0	0	0	0	0	0	0	0	0	0
03 BOILERMAKERS-WELDERS (NUCLEAR	0	0	0	0	0	0	0	0	0	0	0	0
04 BRICKLAYERS-STONEMASONS	62973	62724	66606	66040	71987	70985	79356	78738	84228	84830	55885	93100
05 CARPENTERS	164436	164458	162589	163758	170884	184659	190272	200885	208580	212203	200006	187533
06 CEMENT-CONCRETE FINISHERS	20537	20690	21971	21066	21328	22308	23874	25409	27739	28577	28158	27965
07 DRYWALL INSTALLERS	9446	5978	5449	9071	9530	10049	10783	12851	13362	12839	13403	13220
08 ELECTRICIANS	78613	81575	85526	83110	83774	86975	92421	95662	108926	110673	112595	111998
09 ELECTRICIAN-LINE ERECTORS	0	0	0	0	0	0	0	0	0	0	0	0
10 ELEVATOR CONSTRUCTORS	7139	7541	7769	7609	7700	7843	8413	9262	10088	10087	10720	10674
11 GLAZIERS	4849	5447	5695	5652	5281	5600	5600	6486	7359	7308	7550	7592
12 IRONWORKERS-ORNAMENTAL,STRUCTU	17620	17897	18248	18174	19427	20028	21531	22620	23851	23667	25071	24183
13 IRONWORKERS-REINFORCING	43847	42884	41953	42676	45146	48456	50302	51481	52831	54492	51154	46946
14 LABORERS-NOT OTHERWISE COUNTED	277591	275775	275699	278684	292985	309120	323516	338456	352877	360165	345853	329141
15 LATHERS	23669	24338	23884	23800	25803	26318	28706	31710	32837	31753	35504	34099
16 MILLWRIGHTS	5797	5386	5461	5461	5920	5823	6979	7356	7215	7566	8185	7519
17 OPERATING ENGINEERS	22702	21523	21632	23668	25129	25516	26025	26774	27606	28674	26147	23290
18 PAINTERS	13362	15546	17531	17328	14591	15265	14466	16969	20936	22044	21003	21982
19 PILEDRIVERS	0	0	0	0	0	0	0	0	0	0	0	0
20 PIPEFITTERS	33837	34305	35660	34882	36046	37226	40047	42268	45403	46230	47239	46351
21 PIPEFITTER-WELDERS (NUCLEAR CE	0	0	0	0	0	0	0	0	0	0	0	0
22 PLASTERERS	20569	21623	20474	15657	20651	21773	23366	27847	28953	27820	29041	28647
23 PLUMBERS	63918	64801	67358	65889	68088	70313	75642	75836	85756	87319	89226	87548
24 ROOFERS	6870	6650	6779	6697	7336	7542	8435	8867	9037	9087	5756	9185
25 SHEET METAL WORKERS	64711	65708	68649	66894	69250	69779	76988	81403	87356	89123	94018	92702
26 SOFT FLOOR LAYERS	1833	2235	2472	2416	2028	2156	1963	2366	2973	3054	2881	3112
27 TILE, TERRAZO AND MARBLE SETTE	6033	7173	7365	6952	6212	6875	6536	8105	9571	9228	[illegible]	9565
28 TRUCK DRIVERS	5085	5546	5045	5361	5575	5712	5853	6173	6477	6735	6021	5553
29 OTHER CONSTRUCTION WORKERS	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	976549	985941	1000866	997435	1038125	1083706	1146514	1212609	1283420	1303078	1304247	1253776
VPIP CURRENT DOLLARS	48964	45448	50185	49994	52020	54303	57451	60744	64291	65287	65345	62820
VPIP CONSTANT DOLLARS	40216	40603	41217	41077	42752	44629	47216	49938	52855	53664	53712	51632

Figure 3. ILLUSTRATION OF A SPECIAL REPORT

A. DESIGN CONSIDERATIONS AND CONSTRAINTS

The scope of the task of building a forecasting model for CLDS is best illustrated by noting previous efforts to model the construction sector. Included in these efforts are (1) the nonbusiness construction sector of the Brookings Model;[1] (2) Bischoff's model of nonresidential construction;[2] (3) recent work by Rosen and Jaffee which is restricted to the residential sector of construction;[3] and (4) a recent model of the industry developed by Chase Econometrics for the Bureau of Labor Statistics.[4] All of the above are national models estimated from time series data. The largest model, in terms of number of variables and detail of forecast, is the Chase effort, which includes a total of 112 variables (including those defined by identities) and forecasts for 15 private construction types at the *national* level.

By contrast, the CLDS design distinguishes 29 separate types of construction and includes separate forecasts of public

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[1]Sherman J. Maisel, "Nonbusiness Construction," in "The Brookings Quarterly Econometric Model of the United States," J.S. Duesenberry, G. Fromm, L.R. Klein, and E. Kuh, eds., (New York, Rand-McNally, 1965), pp. 179-202.

[2]C. Bischoff, "A Model of Non-Residential Construction in the US," *American Economic Review*, 60, (May 1979), pp. 10-17.

[3]Dwight M. Jaffee and Kenneth T. Rosen, "Mortgage Credit Availability and Residential Construction Activity," *Brookings Papers on Economic Activity*, 3:1979.

[4]*A Submodel of Construction Activity for the BLS Growth Model*, Chase Econometric Assoc., Inc., Bala Cynwyd, PA (October 1979).

and private construction activity for these types. Table 1 presents the categories maintained by CLDS. The data are accessible at varying levels of *regional* disaggregation, down to the county level. While more of the above models forecast only annual values, CLDS has a requirement for monthly forecasts so as to link actual data (which are updated monthly) with forecast values.

1. Choice of Approach

A primary task in designing the forecasting system was to choose the technique to be applied in building the regional construction model.[1] Three distinct techniques have dominated the field of regional analysis: (1) input-output analysis, (2) regional economic base models, and (3) econometric models.

a. Input-Output Analysis

Input-output analysis was rejected as infeasible given the constraints of time and funds; even if resources permitted, use of input-output techniques would have restricted the analysis to a static framework inappropriate to the forecasting purpose of this exercise. Data availability at the regional level currently limits the usefulness of regional input-output analysis. Finally, input-output studies are incapable of capturing cyclical factors associated with less than full utilization of available resources.

b. Economic Base Model

Construction activity is a "local" industry. The demand for structures is driven by the needs of industry for plants, of commerce for stores and offices, and of residents for

[1]A more extended discussion of this issue is contained in H.J Brumm, *et. al.*, *Enhancing the Forecasting Horizon of the Construction Labor Demand System: A Review of Methods*, IDA P-1359, Institute for Defense Analyses, Arlington, VA (January 1979).

Table 1. CONSTRUCTION TYPES FORECAST BY CLDS

Code	Type	Code	Type
A01	Single Family Homes	B13	Public Service Buildings
A02	2-4 Family Homes	B14	Misc. Nonresidential Bldgs.
A03	Hotels and Motels	B21	Office Buildings
A04	College Housing	B22	Schools
A05	5+ Family Homes	B23	Hospitals
B02	Manufacturing Buildings	D15	Airports (excl. Terminals)
B03	Industrial Buildings	D16	Bridges
B04	Retail Trade and Store	D17	Communication Systems
B05	Service Stations & Repair Garages	D18	Dams and Reservoirs
		D19	Sewers and Waste Disposals
B06	Parking Buildings	D20	Water Systems
B07	Laboratories	D21	Streets and Highways
B08	Warehouses	D22	Civil Works
B09	Amusement, Rec. & Social	D23	Misc. Nonbuilding Construction
B10	Religious Buildings		
B11	Government Admin. Buildings		

housing. The economic base model relates these local demands to the export-oriented "basic" sectors which exist in each local region.

The "basic" sector (or sectors) is a fluid concept--it must be defined appropriately for each region. However, manufacturing activity is usually classed as a basic industry, as is agriculture when it is an important source of local cash income. Less frequently, non-goods-producing industries such as financial services (as in New York), government (in Washington), or transportation services (New Orleans) may conceptually be included in the basic sector.

While a formal economic base model was rejected as too confining an analytic structure for the CLDS effort, elements of the approach have been retained in the more general structure which is discussed below.

c. <u>Econometric System Modeling</u>

The approach adopted by IDA is best identified as econometric system modeling. A theoretic structure is developed which relates the variables to be forecast (in this case, construction activity measures) to other local and national economic and demographic variables. This structure takes the form of a set of mathematical equations combining variables and coefficients. Data on the variables permit estimation of individual coefficient values using multivariate statistical regression analysis. The resulting estimated structure can then be solved to yield forecast values for the dependent variables, given actual past or assumed future values of the key independent variables of the model.

Data on construction starts were available only from 1972. This period was judged inadequate to support estimation of the model using only time-series data. The alternative approach was to exploit the geographical detail of the data by pooling

"cross-sectional data for individual regions. It was hoped originally that the model could be estimated using data for economic areas,[1] however, a review of available data on the explanatory variables of the model established that the state was the smallest economic unit for which adequate data to support estimation existed.

2. Model Linkage

The task of building the construction model was sufficiently complicated to make necessary the maximum use of existing work. Prediction of construction activity required forecasts of local economic activity, population size and distribution, financial variables and prices. These inputs had to be generated by an existing model or forecasting service.

The existing models which generated forecasts of these variables for individual states were carefully reviewed. On the basis of its proven record and suitability for the task, the National Regional Impact Evaluation System (NRIES) was selected as the driving model for CLDS.[2] The existence of this model allowed IDA staff to concentrate their efforts on building a detailed model of the construction sector without having to develop a methodology for generating the general economic variables which determine local construction activity.

3. Distribution of Forecast Values

The necessity of generating monthly forecast values and for distributing forecasts according to size of project was a further hurdle for the CLDS effort. The data, it was decided,

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[1]Economic areas are defined by the Bureau of Economic Analysis; they represent economically integrated subregions in the US. Currently, the nation is divided into 183 such areas.

[2]The NRIES model is described more fully in R.W. Thomas, *et. al.*, *Construction Labor Demand System: Phase II Development Plan*, IDA P-1393, Institute for Defense Analyses, Arlington, VA (March 1979).

would not support direct estimation of a monthly, or even quarterly model. Most of the independent variables were only available monthly. Therefore, it was determined that the basic forecasts would be annual; monthly values would be estimated by applying seasonal factors to the annual value. Size-class distributions would also be estimated, based on historical data, and applied to the annual forecasts. The procedures used are discussed in detail in Chapter IV of this report.

B. CLDS FORECASTING SYSTEM DESIGN

The completed system is depicted in Figure 4. The forecasting process begins with the formulation, by CLDS staff, of the critical assumptions which influence the forecast path of the economy. These assumptions are passed to the staff of NRIES, who generate an economic forecast for each state based on the assumptions and recent historical experience. The forecast values of NRIES variables are then returned to CLDS where they are input into the Regional Construction Starts Model together with projected values for construction cost indices and other industry prices.

The model is solved to generate a set of annual forecasts for individual construction types in each state. These forecasts are carefully reviewed by an analyst to assure their consistency with assumed economic conditions and recent historical experience Errors which may have resulted from data input procedures are detected and corrected.

Once an acceptable set of annual forecasts is achieved, these are input to the *pseudo-project generator,* which distributes the annual totals across months and size classes. In the process, the forecast records are reformatted to be compatible with the data on actual project initiations which are maintained in the CLDS project file.

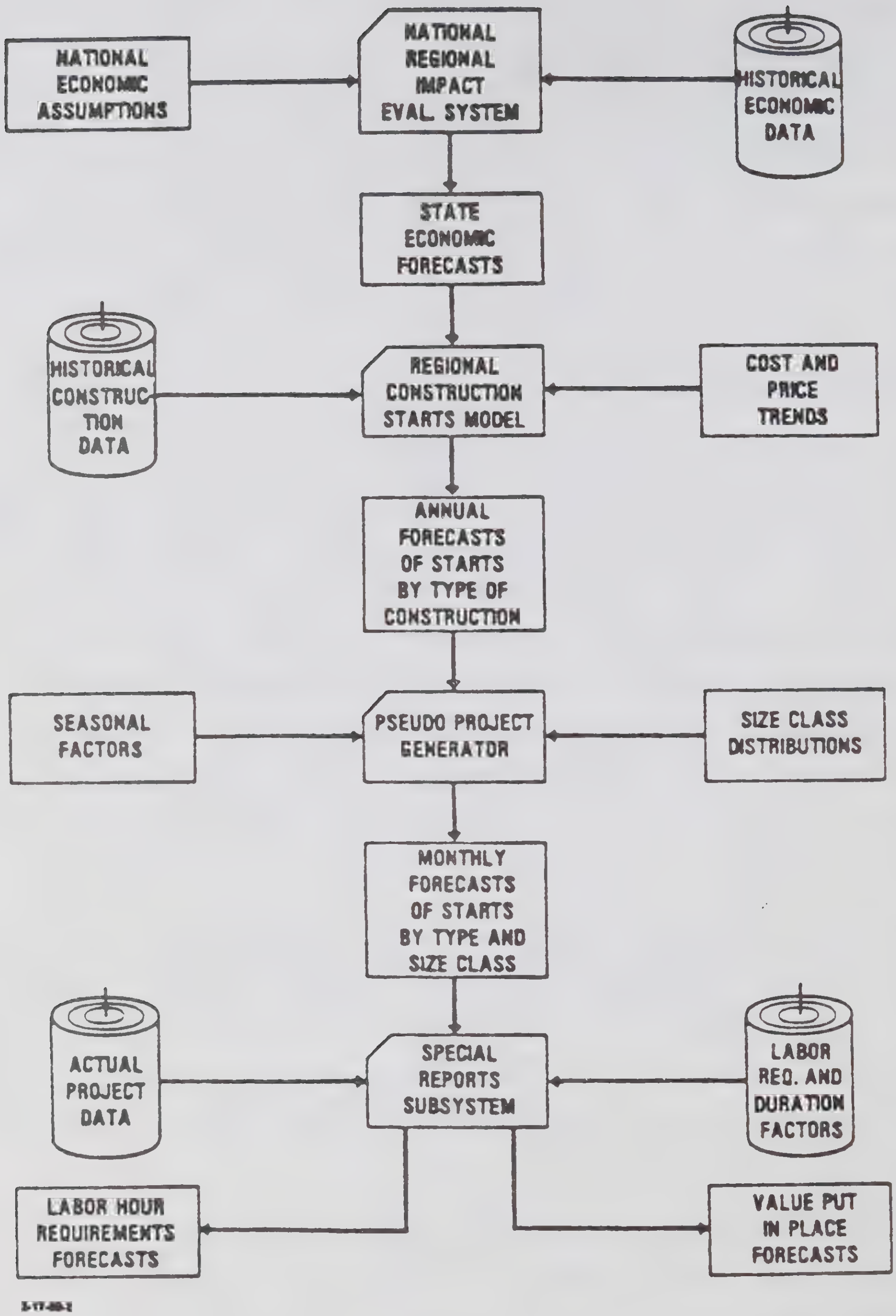

Figure 4. THE CLDS FORECASTING SYSTEM

"In the final forecast step, data on actual projects which are still under construction are combined with the forecasts of future project starts. The Special Reports Subsystem estimates the duration of construction activity for each project, distributes the total cost of the project across the months of activity to generate estimates of value put in place, and distributes the total labor hours requirement across the various crafts required for the specific type of project. The resulting records are then aggregated to produce reports on value put in place and labor requirements for each geographic area. Currently, these reports are available for the following geographic areas: States (51), Federal Regions (10). Census Regions (4), and the Nation (1). The report groups data either by construction sector (residential, nonresidential and nonbuilding construction) or by CLDS type, depending on the level of detail required.

C. MATHEMATICAL FORMULATION OF THE FORECASTING SYSTEM

This section describes the forecasting system as a set of mathematical equations. The presentation corresponds to the nontechnical discussion of the previous section. Detailed discussion of the individual equations of the CLDS forecasting model is deferred to Chapter III.

1. NRIES Model[1]

NRIES is best described as a system of multiregional equations. Behavioral equations are econometrically estimated for each variable in each region using annual time-series data from 1955 to 1976. There are 230 variables for each region and 51

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[1]The following description is extracted with permission of the authors from Kenneth P. Ballard and Robert M. Wendling, "The National-Regional Impact Evaluation System: A Spatial Model of U.S. Economic and Demographic Activity," Paper presented at the meeting of the Regional Science Association, Chicago, Ill., November 1978, mimeo.

"regions corresponding to each of the states and the District of Columbia. All equations in each region are aggregated to form state 'models' which are then aggregated to form the complete NRIES model.

The modeling specification is shown in matrix notation in equation (1):[1]

$$ {}^{r}X_t = A\,{}^{r}X_t + B\,{}^{r}Z_t' + C\,{}^{r}N_t + {}^{r}U_t \;.^{2} \qquad (1) $$

The value of activities of economic and demographic variables (X) within region r, in time period t, is determined by three types of explanatory variables: regional endogenous (X), regional and national exogenous (Z), national and interregional endogenous (N). The first term on the right hand side, $A\,{}^{r}X_t$, represents the regional engodenous variables. These include the region-specific variables that determine intraregional economic activity. For example, regional endogenous variables include the level of local personal income as a determinant of the output in the local service sector.

The second term on the right, $B\,{}^{r}Z_t$, represents regional and national exogenous explanatory variables. The third right hand term, $C\,{}^{r}N_t$, includes the national and interregional endogenous variables. This vector consists of the activity that is exogenous to a particular state-region but is endogenous to the complete NRIES model.

2. CLDS Construction Forecasting Model

The CLDS Construction Forecasting Model contains 185 variables (including variables defined by identities). The

[1]Because of the non-linear estimation of certain equations, there is not a unique reduced-form model specification. The equalities thus hold only for discrete points in time. A Gauss-Seidel iterative solution technique is used to solve the model.

[2]${}^{r}U_t$ represents a stochastic error term.

"complete model specification appears as Appendix A. The basic core of the model consists of 52 stochastic equations of the form:

$$ {}^{r}Y_t = \sum_{i=0}^{m} B_i \, {}^{r}Y_{t-i} + \sum_{i=0}^{n} G_i \, {}^{r}X_{t-i} + HN_t + {}^{r}V_t \qquad (2) $$

where, as before, the r superscript refers to the region (state) and t the time period. Predicted values of the dependent variables (${}^{r}Y_t$) are a function of (1) current and lagged values of other dependent variables (${}^{r}Y_t$), (2) regional economic and demographic variables predicted by NRIES (${}^{r}X_t$), and (3) national variables (N_t). The stochastic error term (${}^{r}V_t$) is currently suppressed in forecasting applications.

Currently the set of dependent variables (${}^{r}Y_t$) include: (a) *housing unit* predictions for three private residential construction types; (b) *value of construction* predictions for two residential and 24 nonresidential types of construction; (c) predictions of average (or unit) values for 14 construction types based on cost trends; (d) predictions of unit values for the remaining 15 types which are recursive in nature; and (e) predictions of housing unit stocks for three residential construction types.

The above equations were estimated using data from 1972-1977 for individual states. Because of the scarcity of time-series data, data for individual states were pooled into the four Census Regions and separate coefficients were estimated for each region. In some cases, data were pooled nationally. Given the pooling procedure, predictions for individual states are the product of individual variable values but (regionally) common coefficient values. To improve the accuracy of the forecasts, in most cases equations include individual intercepts for the various states in the region.

Eighty five other variables are defined through identity relationships. One such group consists of predictions of

"*numbers* of projects, defined as the quotient of the value and average value predictions. Thus

$$^{r}N_t^i = {}^{r}Y_t^i \div ({}^{r}P_t^i) \quad i = 1, \ldots, 29 \qquad (3)$$

where $^{r}N_t^i$ is the number of projects of construction type i in period t for region r, $^{r}Y_t^i$ is the predicted value of such projects, and $^{r}P_t^i$ is the predicted average (unit) value per project for the same time period and region.

Another group of identities serves to aggregate forecasts across construction types. For example,

$$\text{VRES} = \text{VHS1} + \text{VHS2} + \text{VHAM} + \text{VCH} + \text{VHS5} \qquad (4)$$

defines the total value of residential construction (VRES) as the sum of the five residential construction types defined in the CLDS.

Completing the system are 49 regional and national exogenous variables, which together with lagged values of the predicted variables drive the system. Most of these variables are forecast through the NRIES system; in a few cases, values for variables not predicted by NRIES are projected by CLDS staff in preparation for generating a forecast.

3. Pseudo-Project Generator

The forecasts of annual projects by type of construction are distributed seasonally and by size of project by the pseudo-project generator:

$$^{r}P_t^i = {}^{r}N_t^i \; {}^{r}W^i \qquad (5)$$

where $^{r}N_t^i$ is the annual forecast for type i in region r for year t, and $^{r}W^i$ is a 12x8 distribution matrix whose elements are the relative frequencies of projects across the months and size classes. The elements of $^{r}W^i$ were estimated across 1972-1977 for each state and construction type. The resultant

"scaled matrix ($^{r}p_{t}^{i}$) contains the predicted number of projects for each month-size class cell. [. . .]"

Construction in the energy sector differs from construction in the non-energy sector in that each project tends to be unique. The degree of custom work involved is high in energy projects and there are a relatively small number of such projects constructed. To identify the labour requirements of a project in the energy sector, therefore, requires more than just information on capital cost, square footage and the duration of the project. Rather, each major component of the energy project has to be identified and the characteristics of the technology needed for each component must be listed. For instance, for power plants it is necessary to have information on such matters as:

- type of fuel (nuclear, fossil, hydroelectric)
- generating capacity
- type of cooling system
- type of polution-control system
- total number of manhours for on-site construction labour.

The uniqueness of each project, and the length of time required to build these projects (nuclear projects can take a decade to complete), and the frequency of changes in design and technology for these types of project have led CLDS to conclude that it was essential to survey, on a regular basis, each energy project in order to obtain sufficient detailed information for the forecasts in the energy sector. The labour requirements by occupation for each project are estimated by matching that project to a completed project on file having similar characteristics and about which labour information is known. By applying the investment/ physical characteristics-to-labour conversion factors from the completed project to the project under study, the labour requirements are forecasted. For a project using entirely new technology and design, the estimates of labour requirements by the design engineers for the project would normally be used.

Profiles are now maintained on the following types of energy projects: (See pp. C-3.23a, b, c.)*

Institutional Arrangements for CLDS

The CLDS, originally developed through the combined efforts of the Department of Labor, Department of Energy, and the Tennessee Valley Authority, is now operated by the Department of Labor in Washington, D.C.

The CLDS has primarily operated as an internal operation in the Department of Labor. The System has been used mainly by the public sector in the U.S. It was developed with minimal input from labour or business or the state governments; now that the System is fully operational, however, there has been increased communication with some of these parties. No formal institutional arrangements have been made, however, to include any of them in the management or operation of the System. As the System develops and its operation and output become more widely known, more formal communication channels will most likely have to be structured between CLDS and the other major parties interested in construction labour.

The staff of the CLDS is 19 in number and is composed of an executive director, a director of research, professional researchers and support staff.

The Cost and Financing of CLDS

CLDS has been financed mainly by the Department of Labor, with some inputs from the Department of Energy and the Tennessee Valley Authority in the form of funding for special projects and services or information provided. However, these funds have been insufficient and supplemental funding has been derived from doing special projects.

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* CLDS, Energy Sector, "Energy Construction Projects; Data Base Guidelines", Washington, December 1979, Appendix A.

1. Electric Power Plants and Transmission

11. Nuclear Power Plants

111. Boiling Water Reactor (BWR)
112. Pressurized Water Reactor (PWR)
113. High Temperature Gas Reactor (HTGR)
114. Nuclear Unknown and Other Types

12. Fossil Power Plants

121. Coal-fired power plants
122. Oil-fired power plants
123. Gas-fired power plants
124. Power plant Conversion

13. Hydroelectric Power Plants

131. Concrete Dam power plants
132. Earth Dam power plants
133. Generating unit addition
134. Pumped storage power plants

14. Electricity Transmission and Substation

141. 161 kVac Transmission lines
142. 230 kVac Tranmission lines
143. 345 kVac Transmission lines
144. 500 kVac Transmission lines
145. 765 kVac Transmission lines
146. ± 400 kVdc Transmission lines
147. Electricity Distribution
149. Substations

2. Coal Mining, Refining, Processing and Transportation

21. Coal Mining

211. Underground Coal Mining
212. Surface Coal Mining

22. Coal Refining and Processing

221. Coal Gasification
222. Coal Liquefaction

23. Coal Transportation

231. Coal Terminal facilities
232. Coal Slurry pipelines
233. Coal Railroads

3. Petroleum Production, Refining, Processing and Transportation

31. Oil Development and Production

311. Onshore Oil Recovery
312.- Offshore Oil Recovery
313. Alaskan Oil Recovery

32. Oil Refining and Processing

321. Oil Refineries
322. Oil Gasification

33. Oil Storage

331. Crude Oil Storage Facilities

34. Oil Transportation

341. Oil Terminal Facilities
342. Crude Oil Pipelines
343. Product Pipelines

35. Oil Shale Development and Production

351. Underground Oil Shale Mining
352. Surface Oil Shale Mining
353. In-Situ Shale Oil Recovery
354. Oil Shale Retorting and Upgrading
355. Shale Oil Upgrading

4. Natural Gas Development, Production, Processing and Transportation

41. Gas Development and Production

411. Onshore Gas Recovery
412. Offshore Gas Recovery
413. Alaskan Gas Recovery

42. Natural Gas Processing

421. Natural Gas Processing Plants

43. Natural Gas Storage

431. Natural Gas Storage Facilities

44. Gas Transportation

441. Natural Gas Terminal Facilities
442. Gas Pipeline
443. Gas Distribution Facilities

5. Uranium Mining, Refining, Processing and Storage

51. Uranium Mining

511. Underground Uranium Mining
512. Open pit Uranium Mining
513. Other Uranium Mining

52. Uranium Refining and Processing

521. Uranium Mill
522. Uranium Conversion
523. Uranium Enrichment Plants
524. Nuclear Fuel Fabrication Plants
525. Nuclear Fuel Reprocessing Plants

53. Waste Storage/Disposal

531. High level Waste Storage

6. Other Energy Projects and Facilities

61. Solar Energy Facilities

611. Direct Solar Energy Facilities
612. Wind Energy Facilities

62. Geothermal Energy Facilities

621. Geothermal Power Plant

63. Solid Waste Energy Facilities

631. Solid Waste Collection/Separation Plant
632. Solid Waste Power Plant

64. Tar Sand Energy Facilities

641. Tar Sand Mining
642. Tar Sand Processing

The cost of the CLDS has been approximately $1,000,000 total for the initial development and about $300,000 per year for operating the System.

The developmental phase was stretched from the expected two years to five years, because of the shortfalls in funding and the consequent need to take on special projects. The underfunding also has affected the level of maintenance desirable on the System. For instance, it has hindered the updating of the investment-to-labour conversion coefficients, and the re-estimation of the model.

When initiated, the CLDS was primarily intended as a source of information in the process of collective bargaining and a way of reducing the negative effects of cyclicality in the construction labour market. However, it is being used now to:

a) provide general demand information, through its standard publications;
b) produce project simulations (e.g., for major energy or defence projects);
c) make socio-economic impact analyses of major projects or hyper-active construction activity on local and regional labour markets (e.g., the study of the impact of power plants on employment in Utah); and
d) forecast cost and investment trends for various types of construction, particularly those in the energy sector.

Its usefulness in the planning of major projects and in conducting impact analyses is illustrated in the recent study conducted in the State of Utah. The on-site and off-site occupational impact of constructing a series of coal-fired power plants proposed for the State for the 1980s was examined. Labour demand information was obtained, from CLDS for on-site labour and from Utah sources for off-site labour; supply information was provided by Utah sources.*

* This study illustrates a way of using CLDS in a supply/demand model, not at a national level which is currently impossible, but at the state level which is possible beyond the confines of Utah.

The following excerpt describes the general approach of this study:

> "The purpose of this study has been to estimate and evaluate the occupational demands upon the Utah labor force of alternative schedules for the construction of coal-fired power plants in the state during the 1980's. These schedules or scenarios, each of which plots a time path for the construction of eight coal-fired units adding 4,520 MWe of capacity, were defined and compared in Chapter 1. The methodology for the study was developed in Chapter 2 in terms of the estimation procedure for the forecasts of occupational demand and supply, and the special tabulations of Census and Social Security data for an examination of recent labor force immigration to Utah. Chapter 3 presented the results of this demand/supply analysis in terms of potential labor force imbalances, on an occupation-by-occupation basis, likely to occur in the state in 1985 under each of the power plant construction scenarios. Finally, the likelihood of migration responses to these imbalances, and the probable economic-demographic characteristics of potential immigrants to Utah, were examined in Chapter 4." +

Its potential contribution to the planning of training programs and mobility have not been tapped yet, although the Utah study just cited does show some of the potential for use on the subject of mobility.

This utilization pattern has been heavily influenced by clients who have been interested in gaining a better perspective of the construction labour market and its implication for the construction of their projects.

Although client-initiated special requests have imbued the developers of CLDS with significant insights into the operation and capability of the System and provided crucial financial support, they have displaced personnel and resources from the development of the System and have deflected the System from its original purposes. Limited

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\+ H. W. Herzog, Jr., A. M. Schlottmann, W. R. Schriver, "The Occupational Impact of Alternative Coal-Fired Power Plant Construction Futures For the State of Utah", CLDS, Washington, 1980, p. 54.

resources, particularly personnel, have made it difficult to use CLDS for a broad range of tasks on a request basis. Nevertheless, CLDS personnel think there are several uses to which the System should be applied:

- major project simulation
- counter-cyclical and counter-seasonal planning and scheduling
- planning of training and educational requirements
- collective bargaining.

Areas of Future Development

The following areas of the System were mentioned by CLDS as deserving further development or change:

- updating of the investment-to-labour co-efficients
- introduction of structural characteristics of projects (e.g., steel vs concrete) into the investment profile in the model
- re-estimation of model and checking of reliability of estimation
- improvement of information and methodologies with regard to the timing of engineering construction
- development of quarterly and annual reports to show longer-term trends than is now possible with the month-to-month schedules
- the lengthening of both energy and non-energy forecasts to ten years from the current five
- introduction of information on own-account construction, and on major repairs and maintenance
- determining whether the occupations covered are appropriate and in the right level of detail in terms of specialization; information on engineers, and possibly technologists and technicians, should be considered for inclusion

- re-evaluation of the number of construction types, to determine whether the present number and detail is appropriate
- improvement of software, and possibly disaggregate selected types of construction so that they can be run on mini-computors rather than on the main frame.

Appendix C-4

THE ALBERTA DEPARTMENT OF ADVANCED EDUCATION AND MANPOWER

Since the mid-1970s, The Alberta Department of Advanced Education and Manpower (ADAEM) has been working on the preparation of forecasts of labour in the construction industry and have published them in the series "The Construction Industry: Activity, Labour Demand and Supply, Alberta". At the time of writing, the latest report was the one of December 1979, with another planned for release in the Spring of 1981.

The following pages describe the general forecast approach in use for the 1979 report:[1]

> "Ideally, forecasts of labour demand and labour supply should be compared to estimate potential occupational shortages or surpluses. Although we /Alberta, Department of Advanced Education and Manpower/ have obtained estimates of construction labour demand for several trades, the available data on construction labour supply is lacking.
>
> In light of the above we /Alberta DAEM/ have in earlier reports compared indexes of construction labour demand with indexes of labour supply for several trades. Some difficulty was experienced in interpreting these indexes, especially in those cases where the supply is not restricted to only construction activity. Therefore we are introducing /in December 1979/ an alternative approach of comparing flows of demand and supply. The flow of demand is termed the manpower requirement, which is defined as a sum of the change in demand and an attrition component. The latter represents those who retire, die or withdraw from the occupation."

> "Construction activity, expressed in constant dollar values, was projected to 1988 based on historical trends and anticipated future aberrations from these trends. In addition, projections of the residential, gas and oil and other engineering sectors of construction, which were based

1/ This description is excerpted from ADAEM, "The Construction Industry: Activity, Labour Demand and Supply, Alberta", December 1979, pp. 27 and 31-32.

on variables unique to each sector, were incorporated into the forecast. These projections included all repair and new construction activity in the province regardless of whether the construction is done by the construction industry or 'own force' construction manpower employed directly by establishments in other industries. The projections do not include the purchase value of land and existing buildings.

The impacts of major projects, such as oil sands plants and the petrochemical complex, were of such importance as to make it desirable that their effects be isolated. Therefore, the 'other engineering sector' was split into two sections. One section includes all 'large projects', the other section includes bridges, recreational structures, etc. This classification follows Statistics Canada's system, which classifies the major projects as 'other engineering' due to the secrecy provisions of the Statistics Act."

"Based on the forecast of construction dollar volume, the demand for labour, excluding that required for several large projects, was estimated by applying coefficients of manhours needed per thousand constant dollars of construction expenditures. These coefficients vary for each construction sector. Since construction labour demand is expenditure based, it includes workers engaged in construction activity and repair activity in the construction industry itself, as well as in other industries.

The demand for each trade was estimated as percentages of the total labour demand for each sector. Each trade demand was then adjusted for changing productivity and the effects of technological change.

For the excluded large projects mentioned above, average manpower requirements submitted by individual project owners were used instead of those generated by the model.

It should be noted that because of the use of averages and the large variance in manpower requirements over a year, our reported demand does underestimate the peak demand which occurs in the summer months."

For the 1981 report, considerable work has been done to improve the data and methodologies on both supply and demand. This includes up-dating of the investment-to-labour co-efficients and computerization of

data on apprentices to improve the availability of flow data and its use. Further development is planned, especially for the supply side, which is regarded as being less well-developed than demand. More up-to-date information is needed on the stock of labour in the industry as well as better information on attrition and all types of mobility.

The forecasts are distributed widely and the results are discussed with representatives of labour and business on advisory councils throughout the province. The forecasts provide the basis for discussions and the reaching of a general understanding by labour, business, and government about the major trends expected for the future. This regular tripartite communication was cited as being a major reason for the success of the forecasts as a policy-developing tool. Generally speaking, the forecasts have been influential in getting labour and business to accept the need for taking a longer time perspective on manpower planning and training. The forecasts themselves and the responses from business and labour have been important inputs into the program and policy-planning efforts of the provincial government and especially ADAEM in such areas as training and capital investment.

Appendix C-5

THE CANADA EMPLOYMENT AND IMMIGRATION COMMISSION SASKATCHEWAN REGION

The Occupational Review System is an attempt to identify critical occupational needs in the Saskatchewan economy for the purpose of providing program and client (employer and employee) direction.

The system, still in its developmental stage, has two elements - CURRENT IMBALANCES and FUTURE DEMAND.

CURRENT IMBALANCES employs information from three CEIC operational systems to track demand and supply imbalances for 61 selected occupations.[1]

1. National Job Bank (NJB) -

   The number of Saskatchewan job vacancies in the National Job Bank at the end of each quarter; to the degree that CEC's are used by employers, this provides a measure of unfilled labour demand.

2. Foreign Worker Recruitment -

   The number of offers of employment authorized for foreign workers during the quarter; this also provides a measure of unfilled demand.

Nos. 1 and 2. together provide the best estimate of current unfilled demand. While it is recognized that our CEC's do not have complete penetration in the labour market, no attempt will be made to inflate NJB data.[2] CEC penetration rates in the labour market are not known and vary with occupations and with changes both in the seasons and the economic cycle.

1/ Sixty-one occupations were selected on the basis of their continuing demand and or supply nature, CETP and CEITP implications, and provincial educational implication. Consideration for occupational inclusion or exclusion to the system is carried out on an on-going basis. See Appendix 1 for a list of presently included occupations.

2/ 1st Quarter 1980 Review did inflate NJB data in an attempt to estimate all vacancies.

* This description is reproduced from: Canada Employment and Immigration Commission, Saskatchewan Occupational Review, 2nd Quarter, 1980, pp. 3-4.

3. Unemployment Insurance Claimant Data -

The number of type 2 claimants (those who are available for work) who are receiving benefits at the end of each quarter. Trainees on UI are excluded since they are not available for work. This data provides the best estimate of current supply of manpower.

FUTURE OCCUPATIONAL DEMAND information is obtained on major Saskatchewan projects activity for a five-year period. To this is added an estimate of occupational drain to Alberta's mega projects.[1] This information provides estimates of future trades demand only. Professional and technical occupations with good future demand prospects are highlighted with co-operation from our CEIC on campus offices from their records of employers recruiting graduates on campus.

Together, both current and future occupational information provides direct in program areas such as:

- TRAINING
- COUNSELLING-EMPLOYER AND EMPLOYEE
- FEDERAL/PROVINCIAL MANPOWER PLANNING
- AFFIRMATIVE ACTION.

1/ Alberta's Mega Projects - Alaska Highway Gas Pipeline, Cold Lake and Alsands Tarsands.

Appendix C-6

Nova Scotia Department of Labour *et al.*

What is the Construction Trades Inventory (CTI).

> "The Construction Trades Inventory [developed by the Nova Scotia Department of Labour *et al.*] is a statistical base which should give management, labour and government the capacity for improved manpower planning. Information from the inventory has yielded data on the quantities of skilled tradesmen by trade and type, by skill level and by geographic area, indicating the numbers of the total who are currently employed or unemployed. As well the trades inventory has developed a projective capacity which yields not only a current account of the total supply of tradesmen, but also future forecasts of demand and therefore, future utilization levels."[1]

Efforts to develop the inventory were made in the mid 1970s by such organizations as the Design and Construction Institute of Nova Scotia, the Construction Association of Nova Scotia, Nova Scotia Voluntary Planning and others interested in the supply of and demand for construction labour. There had been concern that information was needed for project scheduling and planning, for planning of training and educational programs, for analysis of productivity and for a better understanding of overall supply/demand conditions.

> "The Construction Trades Inventory is based primarily on the 'Feasibility Study of a Proposed Construction Trades Inventory for the Province of Nova Scotia' prepared by D. C. H. Consultants Inc. This study was jointly funded by DREE (Nova Scotia) and the Nova Scotia Department of Labour."[2]

1/ Nova Scotia Department of Labour, Labour Research Division, "Construction Industry Five Year Forecasts", news release, no date.

2/ *Op. cit.*

Although some modifications were made in this approach when the pilot project was implemented, many of the recommendations in the consultants' report were followed; from this report cited above, their main recommendations were as follows:

> ". . .
>
> In our Interim Phase I Report, we outlined three inventory options differentiated from one another by degrees of complexity, sophistication and capability of output. The first two, while varying in detail of content, were restricted to output that would be a current accounting, periodically updated, of quantities of skilled tradesmen, by trade type, by skill level and by geographical area, indicating the numbers of the total who are currently employed and unemployed. The third option was distinguished from the first two by adding components that would give the inventory a projective capability, yielding not only current accounting of total supply (employed and unemployed) but also future forecasts of demand and, therefore, future utilization levels. The third option broadens the potential applications and usefulness of the inventory.
>
> It is the recommendation of our Report that, in spite of the increased complexity of the third option, it is in fact the only one which can be pursued with any expectation of success. That recommendation is based on the following conclusions:
>
> a) The third option is the only one which can yield the full range of possible benefits.[..]
>
> b) In spite of technical constraints that will limit the accuracy of the forecasting applications of the inventory[..], the third option inventory will yield greatly improved planning support for pursuit of the objectives identified [..].
>
> c) The third option is the only one which will be satisfactory to the unions. Put more strongly, it is a fact that union participation cannot be expected unless the unions can foresee a benefit returning to them. The crucial benefits from their point of view are counter-cyclical scheduling of projects as a stabilization policy and improved manpower training programs. Only an inventory with a projective

capability incorporating both future supply and demand components will meet the information requirements of such planning initiatives. Consequently, only the third option will be acceptable to the unions and draw their crucial commitment[...].It is the union's perception of a more general point, that a current accounting of labour supply is of no planning use whatsoever, except as base information for future projections. Given a two month lag from the point of data collection, the product is historical information.

d) The additional costs of adopting the third, as opposed to either of the first two options, are vastly outweighed by the quantifiable and intangible benefits that could accrue to the industry and to the government from the effective uses of the information that a third option inventory would yield....

On the basis of these conclusions, we are recommending that an inventory be established which is a refined version of the Phase I third option and modified to acknowledge the technical constraints on its projective capability....Its defining characteristics will be as follows:

1) The inventory should have sufficient scope to include construction labour supply in the following sectors:

- commercial
- institutional
- industrial
- residential
- civil

2) The output will distinguish skilled tradesmen by trade categories and by sub-trade skill types (e.g. carpenters/form-work, carpenters/drywall, carpenters/finish).

3) The inventory will include both unionized and non-unionized labour.

4) The information will be broken down by three geographical areas:

- Cape Breton Island
- New Glasgow Area
- Halifax Area

5) The numbers of skilled tradesmen will be distinguished by skill levels as follows:

Formal Training	(1- 4 Years (Apprentices)
	(5-10 Years (Journeymen)
	(11-15 Years (Journeymen)
Informal Training	(1- 4 Years
	(5-10 Years
	(11-15 Years

6) The inventory will be established with a capability of forecasting future utilization levels for construction trades supply. Thus, it will incorporate both supply and demand data bases with a projective capability extending through a two to three year forecasting period.

7) The inventory will be updated and published annually, with both current accounts of labour supply and utilization and two to three year projections being published simultaneously.

8) The operation and uses of the inventory will be managed by a steering committee composed of equal representations of union, business and government interests."

"[. . .]

Benefits from a construction trades inventory will accrue to management, labour and government if the information is used. For employers it should provide a basis for project scheduling, costing and planning which in turn should assist in ensuring maximum utilization of Nova Scotia's construction labour force. The inventory is seen as benefitting unions in that it will provide a basis on which membership levels can be planned in order to maintain a reasonable relationship between supply and forecast demand. For government this project is envisioned as a great asset to planning trades training as well as project scheduling."[1]

By 1980, however, due to financial constraints and reorganization within the Nova Scotia Department of Labour, work connected with CTI was postponed. As of the Spring of 1981, there is the expectation

1/ Nova Scotia Department of Labour, Labour Research Division, "Construction Industry Five Year Forecasts", news release, no date.

that the CTI will be re-started once the reorganization within the Labour Department is effected. In the meantime, however, a survey of construction labour supply and demand, using the CTI approach, is being done by consultants for the Scotia Shelf Project.

Management of the Inventory

The program at the time of the pilot project was overseen by a steering committee composed of representatives of labour, management and government. A working group was established that was chaired by an employee of the Nova Scotia Department of Labour and staffed by employees of that department and of the Canada Employment and Immigration Commission and of the Nova Scotia Department of Development.

> "It is felt that this mechanism has contributed greatly to the success of the undertaking and as well ensures that the results of the inventory are distributed to all interested parties for use as a vital planning tool in the construction industry."[1]

When the Inventory resumes its activities under the aegis of the Department of Labour, a similar approach to its management is contemplated.

General Description of the Inventory

The Demand Side

> "The inventory tended to follow the methodologies contained in the original feasibility study done by DCH Consultants Inc. However, in some areas it was necessary to deviate from the consultants methods and develop new ways of obtaining and forecasting the desired statistical information.
>
> In some areas, the methodologies used, leaned heavily on statistical techniques. This was especially the case for the forecasting of future levels of

1/ Op. cit.

construction activity. In some cases it was necessary to introduce into the methodologies a judgemental factor. Construction activity on an aggregated scale can be forecasted with some degree of accuracy and confidence. However, for the sub-sectors within construction this was not possible and thus, there was introduced judgemental factors based on industrial intelligence work. For this type of factor to be introduced discussions were held with appropriate private and public sector individuals and departments. This method for forecasting proved to be very useful in that it brings to any forecast a reality which tends to be missed in basic statistical forecasts.

[. . .]

OVERVIEW OF DEMAND MODEL

Developing a forecast of construction Labour Demand is a formidable task. The inventory research team spent some time looking at various methods of forecasting and finally decided that a combination of statistical and industrial intelligence type analysis would be best suited to the needs of the sector. While total construction expenditures tend to have a relatively stable growth rate, the individual sectors of construction have different cycles and respond to exogenous influences in different directions and amounts and therefore, have an unstable growth rate.

For the purpose of this report construction activity in the province was broken down into 13 major types of structures with the two major sectors, Total Building and Total Engineering, equal to total construction. The use of quantitative methods provided the basic forecast results (preliminary results) while industrial intelligence was used as an adjustment factor as it felt necessary to account for trends and cycles in the industry.

With the type of approach taken for the demand forecast, three basic steps were established to estimate labour demand by occupations. The three steps include:

1) The general methodology of demand, that is the development of the overall demand total.

2) The profile and development of each of the major variables of the demand model.

3) The general forecast results of each sector, estimated from the demand model and industrial intelligence work.

The only divergence from the methodology was for residential construction. It was felt by the research team that this sector of construction plays a major role in the whole industry, thus it was treated by itself. For example, residential construction has accounted for 32 per cent approximately of total construction over the past number of years while its percentage of total building construction is in the 55 - 62 per cent range.

THE DEMAND MODEL

[. . .] In equation form, the model is as follows:

$$\text{Stage 1} - \frac{TE_t \times \text{L Coeff.}_t}{AHW} = TM_t$$

$$\text{Stage 2} - TM_t \times \text{Occ. M} = LD_t$$

TE = Construction Expenditures by Sector (Dollar Volume)

L Coeff. = Labour Coefficients for Construction by Sector (A ratio of output to labour input)

AHW = Average hours worked by a tradesman for one year in the construction industry based on a four year average (1975-1978).

TM = Total manpower requirements in the construction industry by sector.

Occ. M = Occupational Mix of tradesmen by type of structure in the construction industry (in percentage terms).

LD = Occupational Demand by Trade

t = time (time for the labour coefficients is fixed).

Stage I of the model is the development of total manpower requirements per year for the construction industry. When the total forecasted expenditures by sector and the fixed labour coefficients by sector (measured as the number of hours of labour per thousand dollars of construction activity) are combined, the final result yields the total number of hours of labour worked per $1000

dollars of construction for each sector of the industry. The final calculations in Stage I is a division of this total number of hours worked by the average hours worked by a tradesman in the construction industry. This yields the total labour force requirements (TM) for the whole industry by sector. Total labour force requirements are based on the dollar volume of construction activity related to a fixed construction labour input structure for the province of Nova Scotia.

In Stage II of the model the total labour force requirements are broken down into occupational requirements (TM) by the percentage distribution of tradesmen (Occ. M) by structure for the construction industry. The results for each occupation by structure is added together to find the demand requirements for each occupation in the forecast years. The time frame for the forecast period is five years with a twenty year period for the historical background of the industry.

The above information is a general description of how the model operates. The next section turns its attention to how each variable in the model was estimated.

DEFINITION - INDUSTRIES

The definition of the construction industry for the inventory has included:

1) Commercial construction which includes warehouses, shopping centres, offices, etc.

2) Institutional construction including hospitals, schools, churches, etc.

3) Industrial construction which includes processing plants, factories, power generating plants, etc.

4) Residential construction including single family, row, and highrise housing.

5) Civil work including roads, bridges, hydroelectric projects, wharf and dock installations.

CONSTRUCTION DOLLAR EXPENDITURE (TE)

Total construction dollar expenditures were projected by a global approach based on a linear regression model. This global approach was chosen rather than the projection of total construction by summing individual sector projections because of the unstable relationship between each sector. This feature of construction was pointed out by the province of Alberta in their study of the industry, 'Each individual sector of construction has a different cycle and responds to exogenous influences in different directions and amounts, thus producing an unstable growth rate. In contrast, total construction expenditures have a relatively stable growth rate because the cycles of individual sectors are out of phase with each other.' [..]

There are two methods to forecasting the overall total construction dollar volume with a linear regression model: a) using the historical pattern projected into the future, or b) use an explanatory variable or variables if the explanatory variable can be projected. The method used was the gross provincial expenditure as the explanatory variable. The advantages of this method are: 1) the strong relationship between the performance of the provincial economy and the construction industry; 2) the Conference Board of Canada forecasts gross expenditures for each province and is considered a reliable source, as well the two year forecasts are updated each year; 3) there is a close fix between the trend line estimates using the historical pattern as the explainable variable, to the gross provincial expenditures as the explainable variable." [1]

Other points are to be considered when looking at this side of the CTI. The demand is based mainly on recent historical experience and statistically formulated forecasts. There are no current or short-term

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1/ Nova Scotia Department of Labour et al., The Construction Trades Inventory; Pilot Project, Halifax, 1979, (unpublished draft copy), pp. 7-11.

actual construction project data used except perhaps for the larger projects. There are no disaggregations by structural type (e.g., hospitals vs schools) or materials (e.g., concrete vs steel) within the major types of construction (e.g., institutional, industrial, residential). The CTI produces forecasts only for contract construction, but not for own-account (i.e., by non-construction firms using their own workers); given the large percentage of construction activity of this type in Nova Scotia, this considerably underestimates the potential supply needed. Unlike the supply side, the demand side produces data only on the province as a whole but not the major regions within the province.

The Supply Side

"There exists no single existing secondary source of data which can meet all the input requirements of the inventory. Collected data is available from a number of sources, none of them comprehensive and all suffering limitations from the point of view of the requirements of the inventory.

a) Canada Employment and Immigration Commission

1. Canada Manpower Centres - In Nova Scotia, as in most parts of Canada, the union locals serve the placement requirements of the unionized construction tradesmen and the employer through union hiring halls. For this reason the Canada Manpower Centres do not have registered with them the bulk of construction workers who are available for work.

2. Unemployment Insurance - While the U. I. information is an important type of data for the proposed inventory, especially in assessing current labour conditions (e.g. unemployed numbers of non-union tradesmen) it is information on the unemployed only, not the under-employed or the employed.

b) Census - This is a very extensive and detailed study and has contributed to the understanding of a base number of workers. However, it relies on the work of the person completing the form, is very slow in producing information after initial collection in relation to the volatility

of construction activity, and is not taken frequently enough to enable accurate judgements to be made between censuses given the high rate to turnover of the construction work-force.

c) Corporation and Labour Unions Return Act - C.A.L.U.R.A. was not designed for manpower reporting and contains little information on the number of skilled tradesmen or on the number of tradesmen in a specific area. This publication suffers as well from being published too long after the data period being reported to enable any short-term adjustments to be made.

Recent modifications to C.A.L.U.R.A. will result in a reduction of the number of unions covered and has excluded this as a suitable data source for the inventory.

Because of the limitations of these existing data sources, our proposed Nova Scotia inventory had to go to primary information sources to meet the comprehensive and precise planning requirements for which it is designed. Using survey techniques by questionnaire and interview, basic inventory data was collected from:

i) trade union locals for numbers of unionized construction tradesmen in each sub-trade type and at each skill level and for current utilization levels of the total membership;

ii) Construction Association (N.S.) members who described local labour market conditions as well as provided information on the number and size of construction firms operating in the area.

These primary sources were supplemented by the Canada Employment and Immigration Commission information yielding numbers of non-union tradesmen who are unemployed and corraborating union information on numbers of union tradesmen who are unemployed.

DEFINITIONS: TRADES AND AREAS

To date we have identified a tentative list of skill types corresponding to each of the trades to be covered. These follow:

Trade	Skill Types
1. Electricians	(a) Construction or high voltage (b) Residential
2. Boilermakers	
3. Bricklayers	(a) Construction (b) Marine
4. Ironworkers	(a) erectors (b) reinforcing bar layers (c) riggers
5. Carpenters	(a) formwork (b) drywall (c) finish
6. Plumbers/Pipefitters	(a) plumber - industrial with welding (b) plumber - residential (c) sprinklerfitters (d) industrial instrumentation
7. Millwrights	(a) Construction (b) Maintenance
8. Sheet Metal Workers	(a) Installers (b) Fabricators or Benchwork
9. Elevator Constructors	
10. Insulators	
11. Cement Finishers	
12. Painters	
13. Roofers	
14. Operating Engineers	

The division of the province into areas has been done along the lines or areas compatible with union and Canada Employment and Immigration Commission jurisdictions. The areas are as follows:

1.) Cape Breton Island

2.) New Glasgow area, including:
- a) Pictou County
- b) Colchester County
- c) Cumberland County

d) Guysborough County

e) Antigonish County

3.) Halifax area, including:

a) Halifax County

b) Lunenburg County

c) Hants County

d) Queens County

4.) The entire maritime area for unions with one area (for example, ironworkers and boilermakers) (Yarmouth area counties are excluded)

SURVEY OF TRADE UNION LOCALS

It has always been known that to make such an inventory work, it was necessary to obtain information from the various Construction unions. The support and cooperation received by the research staff in their work was excellent with 100 per cent response to the union survey questionnaire. The types of information collected dealt with the following areas:

a) Current Membership Statistics
b) Attrition
c) Sources of Addition to Supply
d) Hiring Hall Information
e) Non-Union Workers
f) Training
g) Future Employment Prospects
h) Detailed Membership Information " 1

Information was also collected on attrition, mobility and flow of future personnel into the industry from educational institutions, apprenticeship, immigration, and on construction occupations.

"One of the most difficult areas in any inventory of this kind is the forecasting of future manpower supply. The problems are probably more pronounced in the construction industry given the nature of the sector and the

1/ Op. cit., pp. 75-78

and the flexibility which participates in this labour market must have to cope with such things as period of unemployment, constant shifting of work places, hazardous working conditions, etc. The inventory by its design was meant to help alleviate the supply information problems which existed. While it does go a long way towards giving manpower planners a good idea of what human resources are available at a certain point in time, problems still persist when one tries to forecast future supply levels. This problem is particularly acute for the construction industry as it must be realized that the labour force is very flexible in terms of geographic, occupational and industry mobility.

Another important aspect of the inventory was to get a better understanding of how the construction labour market operated. For example, when one looks at future manpower requirements for the sector (see demand section of this report) in comparison to existing supply, a straight comparison of the numbers may point to a shortage or extreme over supply of labour given our existing stock of workers. However, one must understand that given the flexibility of the industry and thus its employees, the number of tradesmen working on a particular type of construction in a given area might be expanded for example, by attracting workers from other occupations or other areas. As well, the man hours available to construction firms may be increased within a brief period by more intensive utilization of the existing labour force.

The understanding of the construction labour market is very important when one attempts to assess the future demand for and supply of construction manpower. As was the case with the demand model, judgement factors have been introduced into the supply methodology. The factors, however, are based on analysis of both past and future trends in the construction labour market.

In order to assess the adequacy of future supply levels of construction manpower in relation to the industry's requirements the research staff's first step was to look at the current and past manpower utilization within the industry. The years looked at in detail were 1976 - 1978 as they correspond roughly to the time frame of the Construction Trades Inventory. As well, a complete set of data is available for the time frame for analysis purposes.

The methodology for this sector is divided into three general categories of analysis. The first will be a review of past and future levels of construction activity

to discern if there has been or will be a major shift in emphasis which may create labour market problems. As well, the occupational demand created by past and future levels of activity will be presented.

The second major component of this section will be to describe the supply utilization during the same time frame as was described in the demand section. This we hope will show what supply problems existed during 1976 - 1978 period, if any. A number of different sources of information will be looked at here. They include: 1) Labour Force Statistics

2) Review of Union Membership Statistics

3) U.I.C. Statistics

4) Foreward Occupational Imbalances Listing

[. . .]"[1]

Further work is anticipated to improve the quality of the data and to refine the methodologies used. This applies to the demand side as well.

The Cost of the Pilot Project

The cost of doing the pilot project was less than that estimated by the consultants with total costs, including imputed indirect costs, probably being under $30,000. The length of time and resources needed to survey the union business officers was less than originally anticipated. Much of the cost incurred by the staff was absorbed in the operating budgets of their respective governmental departments.

Future operating costs to duplicate the collection of the same type of data as in the pilot project should be reduced, as procedures are standardized and respondents become accustomed to what is needed from them. However, substantial work is

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1/ Op. cit., pp. 103-104

still needed to develop the inventory to include improved investment-to-labour conversion factors, flow information on supply, and capture of information on own-account construction.

Uses to Date of CTI

The CTI has been used only to a limited extent to date, but much of this lack of use has been due to the limited distribution of the results and the interruption in the work undertaken following its initial publication in 1979. However, there is still strong support for it and willingness on the part of all original participants to continue support for it once it resumes. Governments have gained a much better understanding of how the construction labour market operates and have obtained useful information on which to base decisions about training, education and project scheduling. Buyers of construction, primarily through the services of consulting engineers and architects, have used the information for simulation of labour requirements for their projects to prevailing labour demand/supply conditions and project scheduling. Consultants working on the Scotia Shelf Project have resumed the CTI for the purposes of simulating the availability of labour for oil and gas-related projects and the impact of these projects on the Nova Scotia labour market. The construction association and a few contractors have used the information to gain a better understanding of future supply/demand conditions. Some union officials were disappointed that the CTI was not used for counter-cyclical purposes to provide more stable employment for their members. They expressed concern that a national information system was not in place to give them better information about the labour supply/demand situation in other parts of Canada and the possibility of moving their members to jobs elsewhere. One union official reported that the CTI had provided an opportunity to take a longer-term perspective on training and the need to train apprentices for future increases in demand.

Appendix C-7

THE CONSTRUCTION INDUSTRY REVIEW PANEL AND THE ONTARIO MINISTRY OF LABOUR

Background

"In the Fall of 1972 the Construction Industry Review Panel was appointed to advise the Minister of Labour on all aspects of labour-management relations in the industry. Composed of nine representatives of labour and management it [was] chaired by a representative of the public interest. [...]

The Panel's terms of reference contain the following statement:

> 'The Panel will examine labour-management relations in the construction industry and will recommend to the Minister of Labour and other parties such measures as will contribute in the long run to their improvement, including means of achieving
>
> a) greater stability of employment,
> b) optimum levels of activity,
> c) rewards of production,
>
> and above all, optimum uninterrupted service to clients and the public'.

Considering these instructions, in its early deliberations the Panel concluded that cyclical unemployment caused by the on-off nature of demand was one of the industry's main problems - and one causing concern to both labour and management, as well as the industry's clients. Significantly reducing this cyclicality would not only result in improved labour relations, it would ultimately lower construction costs and provide the basis for improved planning by industry and government.

If cyclicality is to be reduced we first need reliable information on likely supply and demand for each trade. In an effort to provide this information, some of the major client groups had indicated a willingness to make their plans

and forecasts of construction available to an independent agency if it could be used in developing a forecast of labour for each area of the province, and if the information they provided was used in confidence."[1]

To this end, the Construction Industry Review Panel and the Ontario Ministry of Labour, working in conjunction with Peter Barnard Associates, set out to develop a supply/demand forecasting model for Ontario.

The following sections describe the supply and demand sides of the system, including the development of investment-to-labour conversion factors[2]:

The Supply Side

"A. SOURCES OF DATA ON LABOUR SUPPLY

There are certain problems in using conventional data to project labour supply. Available data is far from complete, and is sometimes unsuitable for our purposes. Specifically, data on base year stock is out of date and the official trade classifications are not sufficiently detailed; information on attrition, additions and non-union stock is inadequate. For these reasons, we have supplemented available data by means of a series of interviews with union representatives.

TWO MAIN SOURCES FOR BASE YEAR STOCK

There are two sources of information on the base year stock - census data and union membership data from the CALURA (Company and Labour Union Returns Act) survey. Each source, for our purposes, has advantages and drawbacks. These are as follows:

1/ The Construction Industry Review Panel and the Ontario Ministry of Labour, Supply and Demand for Construction Labour in Ontario; Results of a Pilot Study, Toronto, 1974, pp. i and ii, (prepared by Peter Barnard Associates).

2/ Except where otherwise noted, this section is excerpted from: The Construction Industry Review Panel and The Ontario Ministry of Labour, Reducing Cyclical Unemployment in the Construction Industry; Phase 3 Report: Pilot Project Approach and Methodology, Toronto, 1974, pp. 1.3-1.13, 3.12 and 3.16, (prepared by Peter Barnard Associates).

- Census data. The main advantage of the census data is that it covers both union and non-union workers. The disadvantages, for us, are that the census occupational classification does not fit very well with the more detailed trade classification used in this study. In addition, in the census, workers are classified in an occupation according to their own statement - they may not be qualified, or they may not be perceived as being qualified by prospective employers. Another drawback is that this date is only available for the main census years; that is, 1961 and 1971; the 1971 data is not yet available.

- CALURA data. The advantage of CALURA data is that it is collected annually and is up to date. The main disadvantage is that it does not tell us about the non-union stock. Since this data is available by union classification and not trade classification, other problems arise, because a union may cover more than one trade and a trade may be covered by more than one union. As a result, CALURA data is not sufficiently precise or detailed for our purposes.

NO DATA AVAILABLE
FOR ATTRITION

Attrition of labour supply occurs in three ways; through death and retirement; through the movement of workers among various occupations and industries; through emigration and the migration of workers from Ontario to other provinces. No data is available for measuring attrition to the stock of a trade.

DATA FOR ADDITIONS
IS INCOMPLETE

The sources of addition to supply in a trade are indigenous supply - that is, graduation of workers from apprenticeship programs; the employment of immigrant workers; the employment of workers who have migrated to Ontario from other provinces. To make projections of additions to labour supply for the seventeen trades in the construction industry, we must first distinguish between those trades which are governed by the compulsory certification regulations of the province and those which are not regulated, or where voluntary certification regulations apply.[..]Clearly, data on regulated trades is more easily obtainable than data on those trades which do not require certification.

Satisfactory for Regulated Trades.

In the case of a trade where compulsory certification is required for employment in the trade, all individuals intending to practice the trade in Ontario must obtain a certificate of qualification from the Provincial Government. To obtain the certificate, each individual is required to complete an apprenticeship program, whose duration varies according to trade.

In these trades, therefore, in the short-term, the total potential additions to supply are limited by the number of apprentices in training. The data on the number of apprentices registered in Ontario is available from the Ontario Manpower Training Branch of the Ontario Ministry of Colleges and Universities and can be used to project additions to supply for each of these trades.

Inadequate for Non-Regulated Trades.

In the case of non-regulated trades, or where voluntary certification regulations apply, projecting additions to supply becomes much more difficult, mainly because we lack information on the size of the potential pool which supplements these trades. We have very little reliable information on the number of qualified immigrants joining non-regulated trades and no data at all on the number of [migrants from other provinces.]

[...]

SUPPLEMENTING DATA
ON LABOUR SUPPLY

As we have shown, available data on labour supply is inadequate, so that it was necessary to supplement the conventional sources of information. Our first step was therefore to conduct a series of interviews with union representatives of each trade, asking for comments on available data on base stock, additions etc. and for estimates where data was lacking (i.e. attrition).

Owing to lack of time, we were not able to collect detailed information on the regional labour market; we therefore concentrated on gaining a better understanding of general mobility in the labour force and the relative degree of mobility in region and province. This understanding provided valuable input for the regional forecast.

Interviews with Union Representatives

We have noted in our discussion on the data sources that the 1971 census data by occupation and industry for Ontario was not yet available. The only data available is the CALURA data on union membership, by union and industry, for 1971 and 1972.[...]The CALURA data for earlier years is not cross-classified by industry and is less useful for our purposes.[...]In order to use CALURA data for projecting supply by the trade classifications used in this study, we had first to obtain, for each union, a breakdown of union membership into trades covered by the union. Since this information was not readily available from existing sources, we organized a series of interviews with union representatives. Wanting to keep our information uniform, we asked each union representative identical questions on membership, attrition rates, additions, elasticity of supply and the number of non-union workers. The format of the interviews was as follows:

(a) Stock Data

- comment on statistics on union membership for 1971 and 1972 compiled from CALURA data [...]
- what trades are covered by the union?
- is it possible to break down union membership by trades covered?
- if CALURA data includes both journeymen and apprentices, is it possible to obtain a breakdown of union membership into journeymen and apprentices?

(b) Attrition

- estimate roughly the annual attrition to union membership.

(c) Sources of Additions to Supply

- on the average, what proportion of the new membership into the union comes from:

  (i) immigration?
  (ii) migration to Ontario from other provinces?
  (iii) apprenticeship or any other training program conducted in Ontario?

(d) <u>Elasticity of Supply for Each Trade Covered by the Union.</u>

- what is the nature of the skills required?
- what is the length of training required to acquire these skills?
- what is the nature of the training program?
- what is the number or proportion of retired and other inactive members?
- what is the general attitude towards taking in new members and apprentices?
- what has been the general supply/demand situation over the past three years?
- estimate unemployment rates in the trades at the provincial level?
- are there regional differences in unemployment rates?
- what is the process of transfer between locals for union members?

(e) <u>Number of Non-Union Workers</u>

- estimate the ratio between union and non-union workers.
- is this ratio constant or changing over time?
- are there regional differences in union penetration?
- are there differences in union penetration by type of construction?

- <u>Information comes from nine unions, covering twelve trades</u>. We made efforts to collect information on these questions from all fourteen unions covering the seventeen trades for which projections of labour supply were to be made.[. . .]But given the time limitation for completing this study and the heavy schedules of union representatives, it was only possible to conduct surveys on the following nine unions:

    - Carpenters
    - Sheet Metal Workers
    - Teamsters
    - Boilermakers
    - Electricians
    - Plasterers and Cement Masons
    - Plumbers
    - Elevator Constructors
    - Operating Engineers

  [. . .] The nine unions covered the following trades: Boilermakers, Elevator Constructors, Electricians, Teamsters, Plumbers or Steam Fitters, Carpenters, Drywall and Plasterers, Millwrights, Floor Layers, Cement Masons/Finishers, Operating Engineers, Sheet Metal Workers, and Roofers.

- Data derived from interviews supplied valuable supplementary information to CALURA figures.

  Combining CALURA data with our information on the nine unions interviewed, we were then able to:
  - estimate union membership
  - estimate the base year stock for each trade
  - estimate attrition by trade
  - deduce relative contribution of the various sources of additions to supply in a trade."

The Demand Side

Client investment plans, as collected via surveys, were used to forecast demand in all sectors except residential construction.

"Forecasting regional construction activity by collecting client plans is generally feasible but the accuracy of plans and willingness to participate is lower for some sectors. The different nature and characteristics of each sector of the industry influences the extent to which they plan, their attitude to co-operation and their willingness to schedule to reduce cyclical unemployment. Thus, while in our judgement forecasting is generally feasible, the accuracy of plans and willingness to participate will be lower for some sectors, particularly housing.

- Utilities, government, institutional and industrial construction: Forecasting is quite feasible for these sectors of the industry which account for about half of construction activity in the province. Three year, and in some instances longer term forecasts are prepared by almost all clients. The nature of decision-making, the size of most projects and the large expenditures on repair of existing facilities mean that forecasts are relatively firm. Subject to some uncertainties about the exact timing of the start of some projects, forecasts based on clients' plans should be accurate. Clients in these sectors realize the benefits of regional forecasts and have expressed a willingness to co-operate with an agency set up for this purpose,

provided that the information they supply is kept confidential. Also, there are relatively few clients in these groups and surveying them should not be difficult.

- Commercial: Forecasting for this sector, which accounts for about 10% of construction in the province, is subject to errors due to uncertainties about starting dates for projects. However, since most projects take two to three years to complete, once a project is started, forecasts of activity are accurate over that period. Large owners such as retail and hotel chains, have multi-year plans but rely largely on developers for finding sites and carrying out construction. Land assembly, zoning, financing and other constraints, create uncertainties for this latter group. Owners and larger developers have indicated some willingness to co-operate, but express reservations about the confidentiality of their plans and the benefits of regional forecasts to them.

- Housing: This sector accounts for about 40% of construction but forecasts based on company plans will be incomplete and subject to error. While large developers have multi-year plans, their realization is influenced by many factors subject to change from one year to the next. Also, the bulk of activity in this sector is carried on by small builders who, by and large, do not plan more than one year in advance. In housing, forecasts based on plans would have to be supplemented with more analytical approaches taking into account population, land supply and other factors affecting production."[1]

The analytical approach selected as being most appropriate for forecasting housing construction is regression analysis.

1/ The Construction Industry Review Panel and The Ontario Ministry of Labour, Reducing Cyclical Unemployment in the Construction Industry; Phase I Report: Feasibility of Forecasting, Toronto, 1973, pp. 2-4. (Prepared by Peter Barnard Associates.)

"The process for determining which variables should be used in the regression analysis was a lengthy one. The first step was to review the literature on housing forecasts and related models which pointed to certain classes of variables as being useful as predictors. Turning to published data on these variables we examined the correlation of each to housing starts, employing a regression analysis subroutine.

This process of selection showed that certain variables intuitively felt to have a great deal of influence on housing starts were in fact only useful for very short term forecasting. Mortgage availability, interest rates, and government activity were in this category. In selecting the variables, we were limited by the availability of data at the regional level. Some important and useful variables were available only provincially or even nationally.

Using this process of selection and limiting the choice to data for which published data is readily available, we concluded that the best 3 year forecasts can be derived by employing combinations of the following 5 variables in a regression analysis model: [population, personal disposable income, cost of housing, residential construction expenditure, non-residential construction expenditures]....

. . .

Finally, as for independent variables, historical data on housing starts - the dependent variable - is also needed. Housing start statistics are generally available only on a provincial and metropolitan or urban area basis. To find the historical level of housing starts in a region, we have had to devise a formula which accounts for the number of urban housing starts (published for individual cities) in each region. To that total we added a portion of the non-urban housing starts in the province based on the percentage of non-urban population in the region. The formula for starts per region in a year is then:

$$\text{housing starts} = \text{urban area starts} + \frac{\text{region rural population}}{\text{provincial rural population}} \; \text{provincial non-urban starts}$$

This formula estimates accurately the number of housing starts per year per region. Data is available on urban starts and rural population from Statistics Canada."

"Demand Converted into Manpower Needs[1]

Both the surveys and the residential forecast yielded estimates of future construction activity expressed in dollars or houses or similar units of measurement. But before these estimates of demand could be compared with the estimates of labour supply, they had to be converted into demand for specific types of construction labour.

To make this conversion possible, a series of factors were developed which show the labour requirements which result from each unit of construction activity. Thus for example, it was determined that each mile of new road would require on average, 152 man/days of labourer effort, 66 of teamster and 785 of general operating engineer. In all, conversion factors were developed for thirty-four categories of construction activity .[...] For each category, the distribution of demand for each trade over the average duration of the construction project was developed.

The conversion factors were developed by analysing a few completed projects in each category and relating the usage of the various trades on those projects to some standard unit of measure such as miles of road or millions of dollars. The overall accuracy of the factors was confirmed by applying them to past construction activity as reported by Statistics Canada and comparing the resulting 'forecast' of aggregate demand for labour with reported labour usage. This test indicated that the conversion factors, overall, are accurate to within ± 10%.

However, despite this result, the conversion factors must still be regarded as only approximate. Only about 100 construction projects were analysed in developing the factors for the 34 categories. Before the next forecast more should be added and some of the assumptions

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1/ This section is excerpted from: The Construction Industry Review Panel and The Ontario Ministry of Labour, Reducing Cyclical Unemployment in the Construction Industry, Phase I Report: Feasibility of Forecasting, Toronto, 1973, pp. 12-13. (Prepared by Peter Barnard Associates.)

involved in developing the conversion factors should be reviewed to improve overall accuracy, particularly for the smaller trades.

Program Developed for Processing Data

Because of the large volume of data requiring processing, it was decided that a computer-based system was required. This system, developed with the aid of the Ministry of Labour, Systems and ADP Branch produces a listing of projects planned by each client, matrices showing the demand for and supply of each trade in each region and the province as a whole, and a chart showing the relationship of supply and demand in each trade by quarters over the three year period.

The inputs required are the supply, demand and conversion factor data described above as well as information on the 'base demand', (the demand not revealed by either the surveys or the residential forecast) and estimates of expected future inflation to allow projects costed in different years to be made comparable."

Results of the Feasibility Work

The system, as described, was tested in the field on a pilot project basis and was shown to be generally workable. The Minister of Labour, in his introduction to the report on the pilot project, however, made the following observations:

> "This report is an end and a beginning. It is the end of a long study that has produced tentative estimates of construction labour supply and demand. The Panel has recommended that the Ministry prepare similar forecasts on an on-going basis. To make such an undertaking worthwhile, additional work will be required on the methodology and major improvements will have to be made in the construction labour supply data. Work already done towards filling the gaps in labour supply information suggest that the cost of doing this will be substantial." [1]

1/ The Construction Industry Review Panel and The Ontario Ministry of Labour, Supply and Demand for Construction Labour in Ontario - Results of a Pilot Study, Toronto, 1974, p. i. (Prepared by Peter Barnard Associates.)

The effort was terminated shortly thereafter. The additional reasons for the termination are several, including changes of management personnel for the project, the limited availability of financial support, the difficulty of obtaining a sufficient number of skilled researchers able to work on a long-term basis, and the concerns about undertaking large-scale and expensive surveys to capture the demand information from the non-residential sectors.

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PUBLIC WORKS CANADA ET AL.

Following the publication in 1974 of the Economic Council of Canada's report, Toward More Stable Growth in Construction, the Department of Public Works (DPW) and several other departments and agencies of the federal government addressed the issue of developing better information on construction investment as an important ingredient in efforts to increase stability in the construction industry. A proposal by DPW to do a feasibility study on the development of such a system was agreed upon by the Interdepartmental Committee on the Measurement of Current and Planned Construction. (The Committee consisted of representatives from Statistics Canada, Industry Trade and Commerce, the Economic Council of Canada, the Department of Finance, and Treasury Board.) Under the co-ordination of DPW, a study group was set up to develop The Construction Investment Information System (CIIS).

> "As originally conceived the C.I.I.S. feasibility project team was to consist of a small group of individuals from various Federal departments seconded full-time to the study. Unfortunately due to budget restraints this approach had to be dropped in favour of an approach whereby individuals contributed what they could while at the same time fulfilling their regular duties and responsibilities.
>
> Under that limitation, and within severe resource constraints, the study just completed is less comprehensive than originally intended and incomplete in certain details. . . ." [1]

Though there were manpower supply and demand components included in the forecasting system, the main intent of the information system being examined by the study group was to provide a basis for making decisions that would stabilize construction activity in Canada, primarily by altering the levels and timing of demand.

1/ Public Works Canada et al., A Study of the Feasibility of a Proposed Construction Investment Information System, Ottawa, July 1978, p. 7.

Public Works Canada and the other federal government departments and agencies that participated in the preparation of the proposal for the creation of the Construction Investment Information System did not develop an operational forecasting system, but they did produce some very useful observations about the characteristics of such a system and how it should be established.

The following pages show their findings and recommendations about the proposed CIIS.

> "If stabilization of construction industry activity is a priority, the development of improved information and forecasting capabilities is a more urgent one, for stabilization measures cannot be effective unless based on the best possible information about current activity levels and emerging trends. That is equally true of government policy measures and of self-stabilizing investment planning and project scheduling in the private sector. In fact, there are numbers of specific purposes to which construction activity forecasts have applications that touch critical and present issues: for government, the evaluation of the impact of capital expenditures on employment levels and price movements, and the development of manpower policies and training programs; for the private sector, project scheduling and costing.
>
> The best information is not presently available to any of the actors in the construction industry. It is one of the major findings of the C.I.I.S. study that, while there is, at every level of government and throughout all sectors of the industry, a large number of independently developed information systems, the resources (well over $1 million annually) committed to these efforts are not optimally utilized because:
>
> a) Each independently developed capability duplicates the efforts of others with the result that none even approaches optimal utility and there is no cumulative advance of quality of information and technique.
>
> b) Multiple approaches to investors and contractors for information engenders impatience (which we

have called in the study - 'survey fatigue') and cynicism in the circumstances that no discernible improvement to the health of the industry has resulted from their cooperation.

c) Independently developed systems tend to be based on differing definitions, analytical techniques and parameters with the consequence that their outputs cannot be cross-referenced or aggregated.

d) To the degree that existing systems tend to be designed by users to meet their own needs and that they are developed to varying degrees of adequacy, all actors in the construction industry do not have access to the best possible sources of information.

The Proposed C.I.I.S.

Obviously, the existing situation is a patchy and uneven response to a universal need. The report recommends that it be corrected by the integration of existing information programs into a unified and nationally coordinated system that achieves the objective that: the best possible information be available to all actors in the industry without losing the advantage of decentralized operations which ensure that the great variety of local and unique information needs of individual user participants are quickly and efficiently met.

The report proposes that such a nationally coordinated system can meet those objectives if it is designed according to the following specifications:

a) The information system should comprehend all sectors of the construction industry and have the capability of yielding output by individual sector, by combinations of sectors and for all sectors collectively. If all user groups are to be served, each must have access to the information subset that is precisely relevant to his needs (e.g., road building, housing, or commercial building). However, the system should also be capable of relating such sector-specific information to the entire universe of construction activity.

b) The system should have the capability of supplying information on a regional and sub-regional basis (e.g., road and railway construction in N.E. British Columbia, housing in Toronto, or commercial building

in Halifax). The planning requirements of most potential users will be satisfied only by very disaggregated information, to the lowest level possible.

c) The system should yield information adequate to both short-term - (1-2 years) and medium-term (2-4 years) planning requirements, comprehensive projections for a 1-4-year period, and information on major projects well beyond the 4-year horizon.

d) The system should relate forecast levels of construction activity - to demand thus generated for construction manpower, materials, - equipment and professional and organizational capability. Consequently, the system should yield forecasts of manpower demand, materials demand and other relevant construction input demand.

e) The system becomes a fully developed policy, program and project planning instrument when it has the capability of analyzing demand - in relation to supply yielding forecast capacity utilization levels for construction labour, materials and other critical inputs to the construction process.

It is an implication of the foregoing proposal that participants in such a nationally coordinated information system bear a responsibility for disclosure of information commensurate with their expectations of information forthcoming from the system. Federal government cooperation with provincial governments on the development of the approach will not succeed without the federal government accepting the commitment to participate not only as a user of the system output but as a contributor of input. The government must be prepared to make available its own investment intentions as a critical portion of the data base.

The Proposed Implementation Strategy

The report concludes that the proposed nationally coordinated system can be most efficiently and economically implemented by adopting an incremental approach to its development and by resolutely minimizing the creation of new administrative machinery to operate it, relying instead on the integration of existing capabilities into a unified decentralized network.

Thus the report terminates with the following recommendations:

(i) Functional responsibilities for the development and operation of C.I.I.S. should be appropriately distributed between a central service group and a decentralized network of users and participants.

(ii) The central group should be responsible for overall system design and development, coordination of research, establishment and maintenance of a common national data base and basic demand forecasting system, servicing the participants and users with regular publication of output and ad hoc forecasts on request, technical advice, and instruction to users, monitoring the utility of the system.

(iii) The decentralized network of users and participants should be responsible for data input to the system, for development of user-specific analyses, for the development and maintenance of regional-specific components such as manpower supply, for the provision of information and technical assistance to other users.

(iv) The machinery of the system should be established with minimal requirements for the creation of new institutional entities. In the case of both central and decentralized functions, responsibility should be assigned to institutions possessing existing capabilities adequate to the task.

(v) On the operation of these guidelines, it is required that only one new institutional entity be created:

a central service group with systems management and co-ordination capabilities restricted exclusively to expertise adequate to the <u>management of</u> systems design and development, the <u>management of</u> technical research programs and resources, and the <u>provision of</u> technical services to system participants and users.

(vi) Because the establishment and operation of the system will depend on the cooperative participation of members of all interests in the construction sector (government, industry and labour), it is critical that its management neither be biased nor be seen to be biased to the advantage or disadvantage of any one interest. Consequently, we recommend strongly that effective management be given to all interests. We would recommend that, since the Construction Industry

Development Council qualifies as a truly tripartite entity, a permanent subcommittee be struck to accept executive responsibility for the system and that it be served by a permanent secretariat charged with the functions described in subsection (v) immediately preceding.

(vii) The efficiencies and effectiveness of a centrally managed national network will be realized only if it is supported by an adequate communications system. The system should be designed from the outset as a computer-based communications network."[1]

1/ op. cit., pp. 6-10 of Preface and Summary.

Company programs overcome skill shortage

By Anderson Charters

THE CONVENTIONAL wisdom is that Canada has a shortage of skilled labor.

Two companies that really should be feeling the squeeze in the expanding, high-technology Canadian aerospace industry are Pratt & Whitney Aircraft of Canada Ltd. and Canadair Ltd., both located in the Montreal area.

Canadair, largely because of the remarkable success of the Challenger business jet, has seen its workforce grow to 6,600 from a low of 1,500 in 1976, while Pratt & Whitney, with its world-dominant class of small and medium-size aircraft engines, has experienced a more leisurely growth over the past decade to 6,600 from 4,600.

Nor are the two companies complaining about lack of skilled manpower, but this is because they have managed to recruit and train themselves the people they need.

In the past 3½ years, Canadair, which had 1979 sales of $116 million and expects to do $900-million worth of business by 1984, has trained 1,300 workers at a cost of $7.3 million, $6.8 million of which was paid by the company.

Aging workforce

"We had retained a nucleus of key workers, but their average age was 55," says Jacques Ouellet, Canadair senior vice-president, resources. "The last slowdown lasted seven years, so we lost touch with our former workforce."

There has been a price to pay in productivity — one source says Canadair has a night shift of English-trained workers that fixes up the mistakes made during the day — but the plant still manages to turn out sophisticated aircraft. And the statistic that really counts is the 80%-85% retention rate for employees who have gone through the training programs.

Pratt & Whitney has enjoyed similar success. With sales currently running at $560 million and expected to climb to $980 million by 1984, it spent $750,000 last year on 63,000 man-hours of technical training for 1,000 employees. One important aspect is good relations with educational institutions, says Romi Szawlowski, manager, manpower planning and development.

At Pratt & Whitney one man assembles an entire aircraft engine. The company needs 50 new assemblers a year, and the local community college runs a special course to fill that need.

One important result of the surge in demand for aerospace workers in Quebec has been the creation of Camaq, the Committee for Aerospace Manpower Assessment in Quebec. The committee was set up in 1978 to forecast aerospace manpower requirements, recommended ways of fulfilling such requirements and propose methods of manpower stabilization in the industry. Camaq has three labor representatives, three from management, one member from each of the two levels of government and an independent chairman.

"This could well serve as a fresh model of labor-management co-operation and bring the dawn of new co-operative attitudes," wrote its chairman, Andre Laprade, assistant vice-rector, relations and audit, Concordia University, in his 1979 interim report. His effusive words receive support from management representatives C. G. Campbell of Canadair — "value of co-operation is astounding" — and Szawlowski: — "I never met a group that I feel so positive about."

Union member, Normand Cherry, business agent for the Canadair local of International Association of Machinists & Aerospace Workers, says it is the first time the aerospace industry has been willing to sit down and say what its manpower requirements are for the next five years.

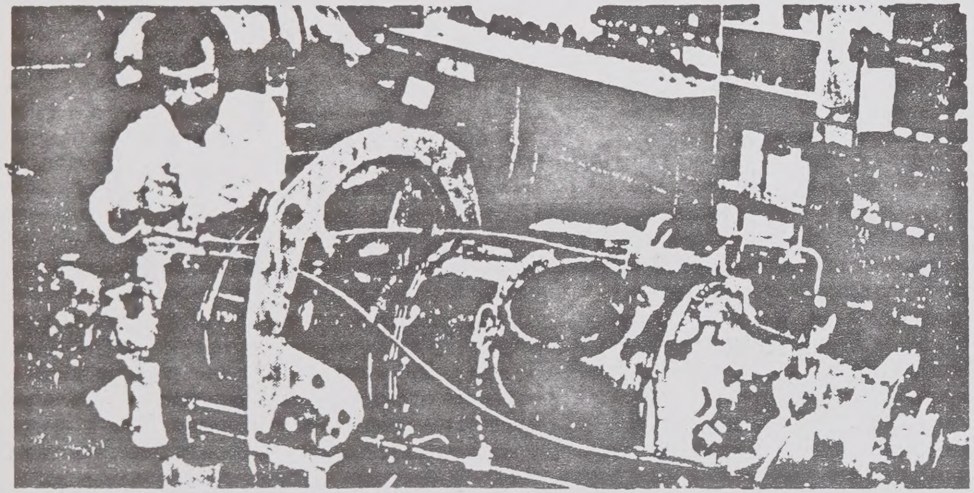
But the good labor relations that existed before Camaq was founded ensured its success. As one committee member puts it, the most important decision was the choice by election of the three labor representatives from 30 different union and employee groups.

Ahead of Ontario

It is no accident, he says, that Camaq is far ahead of its Ontario counterpart. Canadair has not had a strike since 1965 vs de Havilland Aircraft of Canada Ltd. in Toronto which had three in the 1970s.

Meanwhile, Ouellet wants to expand Canadair's existing training facilities to that of a full-time learning institute for the local industrial community. Although he has been thinking of Quebec Department of Education funding for such a program, he would consider the 1978 Labor task forces report recommendation:

"A special fund should be established for skilled trades training into which manufacturing companies would contribute a payroll tax . . . costs should be paid from this fund to employers who establish and operate a recognized apprenticeship training program."


Technical training on the job pays off

Source: The Financial Post, September 6, 1980, p. S10.

Apprentice help given car plants

TORONTO (CP) — The federal government has agreed to provide at least $643,000 for an apprenticeship program aimed at alleviating the shortage of skilled labor in the Canadian auto parts industry.

The Canada Employment and Immigration Commission, co-operating with the Ontario government, has agreed to support the enrolment of at least 186 apprentices in the first year of a projected three-year plan.

Employment Minister Lloyd Axworthy has signed a letter of intent that calls for the commission to pay $643,000 in the first year. The continuation of the project after that depends on government approval of more training funds and the success rate of the program's first phase.

Funding is based on a percentage of the wage paid to the apprentice during each year of the program. Training and wage subsidy costs are estimated at $10,000 for each apprentice.

In the next three years, the member companies of the Automotive Parts Manufacturers Association of Canada have agreed to train 335 people in such high-skill occupations as tool-and-die makers, machinists, maintenance mechanics, mould-makers and welders.

Association president Morley Bursey, who signed the letter of intent along with Ontario Education Minister Bette Stephenson and Axworthy, said the shortage of skilled workers in the auto parts industry has reached serious proportions even though the industry has about 17,000 workers on layoff because of the slump in North American auto sales.

In-school training will be provided by Ontario community colleges or by the participating company. The selected apprentice will have to have a probationary period of employment with the company before taking part in the program.

If all goes smoothly, the number of apprentices will be increased in the second and third years.

The program is one of 30 approved by the federal government with various industrial associations in Ontario.

Source: The Citizen, Ottawa,
October 20, 1980, p.27.